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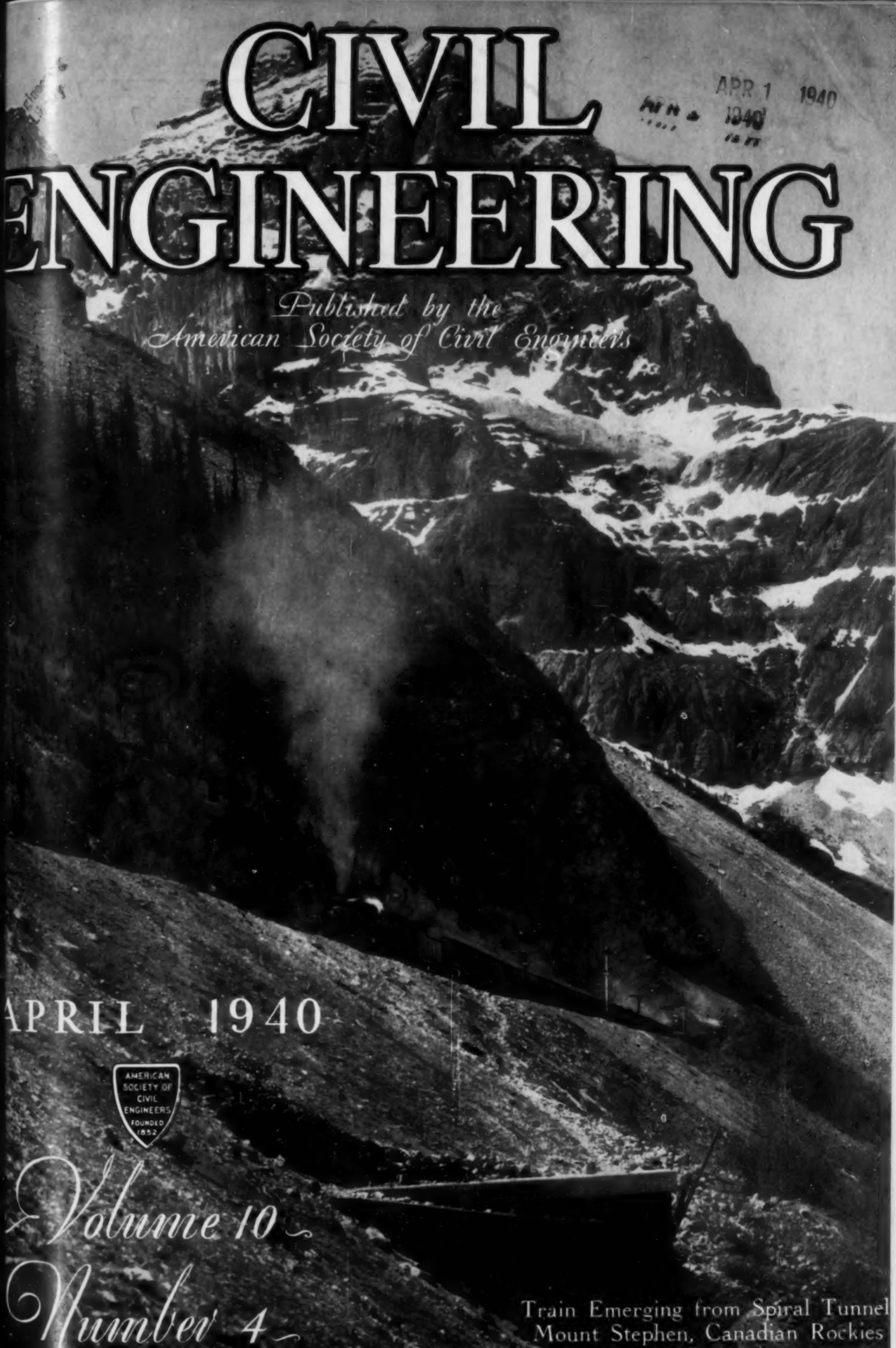


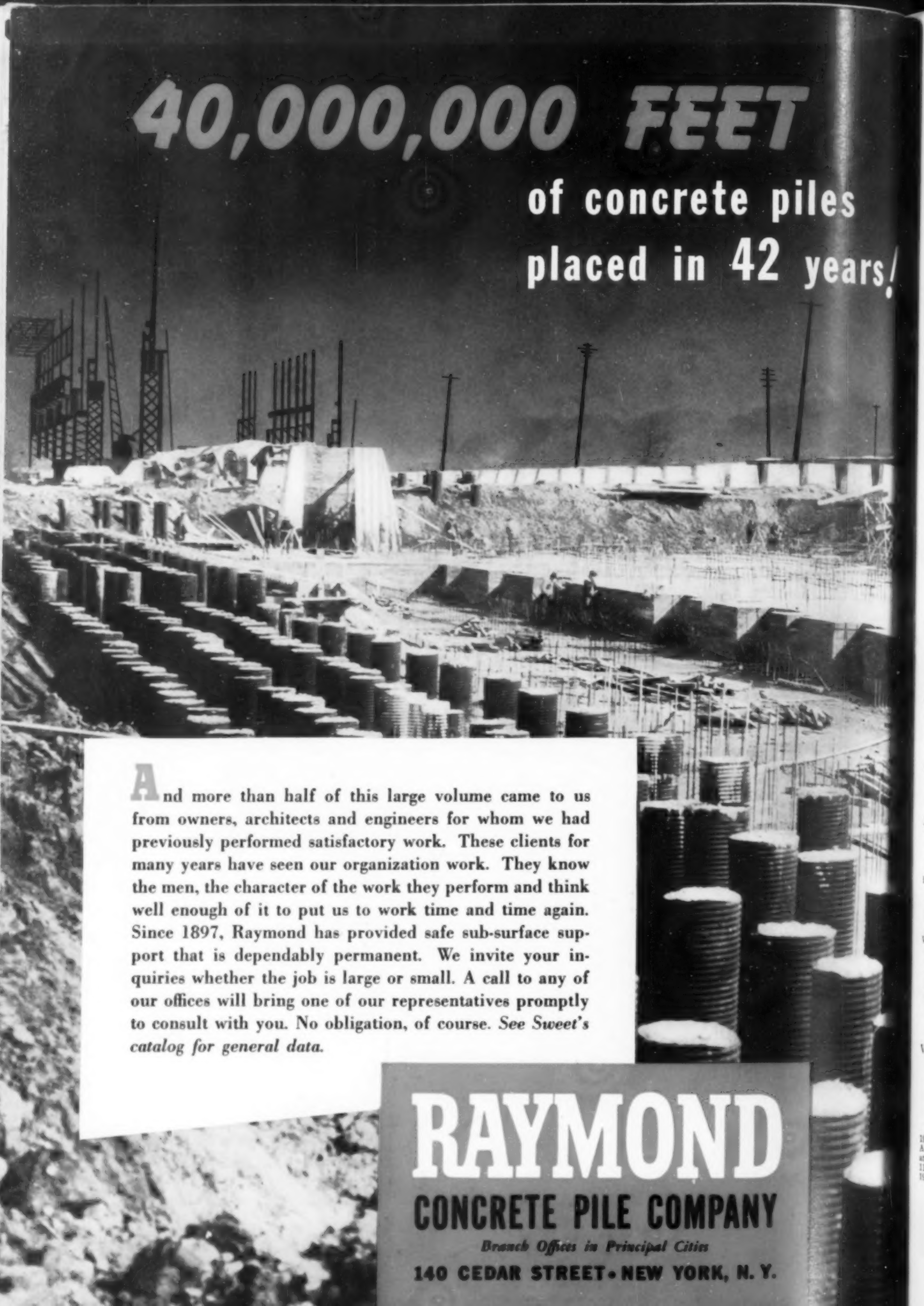
APRIL 1940

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Volume 10

Number 4

Train Emerging from Spiral Tunnel
Mount Stephen, Canadian Rockies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Among Our Writers

Glenn B. Woodruff's experience includes 8 years with the Lehigh Valley Railroad and 7 years as principal assistant to Ralph Modjeski on the design of numerous famous bridges. Since 1931 he has been engineer of design on the San Francisco–Oakland Bay Bridge.

Brehon B. Somervell (U.S. Military Academy, 1914), served in France during the World War as chief of staff of the 89th Division, continuing as assistant chief of staff with the Army of Occupation. He was later Assistant or District Engineer in the New York and other Districts. Since 1936 he has been WPA Administrator for New York City.

A. K. B. Lyman has served in the Engineer Corps since 1909, including 14 years in direct charge of work on the Mississippi and Ohio rivers, on the Great Lakes, and in Boston. Since 1936, in Boston, he has supervised Cape Cod Canal construction, harbor dredging, and flood control work, including Franklin Falls and Blackwater dams.

F. H. Frankland has been with the American Institute of Steel Construction since 1928, serving as chief engineer since 1933. Earlier experience includes a period as managing engineer and partner of Waddell and Sons (1916–1920); two years in private practice; and 8 years as structural engineer for Dwight P. Robinson and Co.

F. B. Farquharson (U. of Washington, 1923) joined the faculty at that university in 1925 and is now in charge of courses in mechanics of materials, the Photoelastic Laboratory, and the Structural Models Laboratory. He is at present engaged on dynamic model studies for the Tacoma Narrows Suspension Bridge.

R. G. Hennes (B.S., Notre Dame, 1927; M.S., M.I.T., 1928) has been in charge of soil mechanics at the U. of Washington since 1934. Previous experience included soil sampling, foundations, tunnels, and earthwork. He has contributed various papers and discussions on soil mechanics to the technical press.

William R. Bandy has been making surveys and resurveys of the U.S. public lands during most of his career, and is still so engaged. For four years (1907–1910) he practiced irrigation engineering in Wyoming and Idaho. His recent activities include the survey of the revised boundaries of Yellowstone Park.

Glenn S. Reeves (Rensselaer Polytechnic Inst., C.E., 1916) after varied engineering experience, including war service with the 23rd Engineers overseas, and later as engineer for the North Jersey Transit Commission, joined The Port of New York Authority as transit engineer in 1927. Since 1930 he has been engineer of port development, engaged in economic and research studies.

Ralph Budd, president C.B. & Q.RR., has been in railroad work without a day's interruption since January 1, 1900. He has taken a leading part in initiating and advancing the use of light-weight railroad equipment. Prior to 1932 he was president of the Great Northern, and responsible for its Cascade Tunnel and electrification.

Miles S. Kersten (U. of Minnesota, 1934; M.S., 1936) worked as junior engineer in soils research with the Minnesota State Highway Dept. until 1937, when he went to his present position as instructor in highway engineering at his alma mater.

Jacob Crane (U. of Michigan, 1913) has had experience in city planning and zoning in 60 American cities. He is now Assistant Administrator, U. S. Housing Authority, and consultant to the National Resources Committee and the Federal Housing Administration.

Elbert Peets (Western Reserve U.; Harvard) has had wide experience in land subdivision and city planning. With Jacob Crane he made the town plan for the well-known "green-belt town" of Greendale, Wis. He is co-author with Werner Hegemann of *Civic Art*.

W. W. Horner (Washington U., B.S., 1905; C.E., 1909), a former Director of the Society, is a consulting engineer, and professor of hydraulic and sanitary engineering at Washington U. Harry Kroeger, Henry I. Stewart, J. K. Bartlett, and T. G. Pfiffner are senior students at the University, and members of the Society's Student Chapter.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

The Responsibility for Sponsoring Research

By Glenn B. Woodruff

Member American Society of Civil Engineers
Engineer of Design, San Francisco–Oakland Bay Bridge, San Francisco, Calif.

EVERY engineer is indebted to his predecessors in the profession for the information that makes it possible for him to design and construct efficient structures. Each project, large or small, owes its success to the adoption of methods that have been developed on previous ones. The individual engineer can repay this obligation by securing and making available to others the additional knowledge that is being developed in his practice. Many, however, have a greater opportunity—that of bringing to the attention of those in charge of the financing of a project the need for this additional knowledge, the fact that in the case of several projects the policy of providing funds for experimental research has been adopted, and the further fact that an appropriation for similar investigations is a legitimate charge against any contemplated construction.

Advances Made Possible.~The need for the information that can be supplied by research would become immediately apparent if all engineers would make a constant effort to distinguish between established fact, extrapolation of test data, assumptions, and empirical rules. In the last few years, new records for size have been established on all kinds of structures. There have been marked advances in the mathematical theories of design. These theories are based upon assumptions, not only as to the basic properties of materials, but as to the action of structural members and combinations of various materials.

There is little question but that several of the formulas derived from these theories are far more precise than is warranted by the accuracy of the assumptions on which they are based. Unfortunately, there is a tendency on the part of designers to have such confidence in their mathematics as to lose sight of the basic data. There is a definite need of experimental investigation to establish, modify, or disprove the validity of the basic assumptions, and to indicate the extent to which these assumptions require modification by reason of actual, rather than theoretical, conditions.

This additional information is not required solely, or especially, for the design of major structures. In fact, the questions that give the thoughtful designer the most trouble are concerned with comparatively minor details, and such details occur as frequently on minor as on major structures.

Typical Structural Research.~On countless problems further investigations are urgently needed. All Technical Divisions of the Society are engaged in gathering and disseminating information of this nature. Typical of the many problems before the Structural Division are the following:

- Fatigue of structural members and connections
- Composite action of steel and concrete in the floors of bridges and buildings
- Distribution of loads between the stringers of highway bridges

Engineers have a justifiable pride in their past achievements. Perhaps the extent to which these have been made possible by laboratory research is not generally recognized; but in any case, this pride must suffer by comparison of these achievements with those in other industries such as the automotive, aeronautical, electrical, and chemical fields. If the extent of the progress made through such experimental research is considered, it seems probable that equal efforts in the construction field would yield results that are comparable, though perhaps not as spectacular.

Warranted by Benefits.~Expenditures for research can only be justified on the basis of the benefits that will accrue from them. Judging from previous investigations, the results should permit of further refinements and greater confidence in design, and better and more economical construction. As an example, the program of the Portland Cement Association has made it possible to produce better and more permanent concrete at a lower cost. It has furnished information that permits of more economical design and designs of more pleasing appearance.

Research in both gas and electric arc welding has not only made certain forms of construction more economical, but pointed to the development of new forms of construction. The investigations by Hunley on impact in railroad bridges made it possible to retain structures in service that otherwise would have had to be rebuilt or restricted as to loading.

The primary responsibility for providing the funds necessary to assure a continuous research program must be placed on those responsible for financing construction. The efficient construction of any project depends on the results of previous investigations. Usually, a project is only one of several that are under consideration. If the results of an investigation cannot be made available in time to benefit the original one, they may aid toward the design and construction of those that follow.

Progress Already.—There are several instances in which those directly in charge of larger projects have provided the necessary funds for research. As examples, in the single field of bridges, the following may be mentioned:

QUEBEC BRIDGE
- Nickel steel riveted joints
- Column tests—three series
- Cross-loaded and counterpoised eyebars
- Friction on pins
- Tension tests—plates and fabricated members

DELAWARE RIVER BRIDGE
- Cable wire
- Suspender rope
- Parallel wire strands
- Cable bending
- Friction of cable bonds
- Compacting of cables
- Buckling of column web plates
- Reinforcing of roadway slabs

GEORGE WASHINGTON BRIDGE
- Large-size columns

SAN FRANCISCO–OAKLAND BAY BRIDGE
- Suspension bridge models
- Fatigue tests of riveted joints
- Static tests of large riveted joints

GOLDEN GATE BRIDGE
- Model analysis of suspension bridge towers

These tests have been made at the engineering materials laboratories of several universities and of the U.S. Bureau of Standards. Compared with the total cost of the projects, the expense of the experiments has been negligible, in the order of one-tenth of one per cent. The results of these tests have furnished much information that is influencing the design of structures being built today; there remains, however, a need for still further investigations.

Commercial Efforts.—In fields that are commercially competitive, it has been necessary to devote comparatively large sums to research in order to keep abreast of, and if possible in advance of, competitors. As an example, the development of the automobile has been made possible only by a continuous program of investigation covering materials, design, and manufacture. Incidentally, this research has been of great advantage to the construction industry in contributing toward the development of construction equipment, illustrating that, in general, the results of any program affect a wider field than that toward which it is primarily directed. Also, the research is usually financed by the manufacturer of the finished article rather than by the producer of materials. In construction, those in charge of the financing correspond to the manufacturer.

There has been a considerable amount of research done by manufacturers or trade associations in attempts to widen the application of their products. The progressive work of the Portland Cement Association has been noted. Mention should also be made of the research done by the Aluminum Company of America, which has made it possible for engineers to take advantage of the light weight of aluminum and at the same time secure adequate strength. However, competitive conditions are such that associations or manufacturers cannot be expected to contribute toward research unless some direct financial reward may be anticipated.

In isolated cases, successful appeals for financing research might be made to foundations established for scientific purposes. It is improbable that a steady flow of funds could thus be obtained; furthermore, as a matter of pride, the construction industry should not place itself in the position of a recipient of charity.

Financing, a Problem.—In listing examples of research, special mention should be made of the Bureau of Reclamation, the Bureau of Public Roads, and the Corps of Engineers. The research departments o several state highway organizations also are doing notable work.

Money for the required research can be obtained only upon solicitation. No one can be expected to supply funds without knowing the purpose for which they will be used, without having assurance that they will be wisely expended, without evidence that further research is needed on the subject considered, and without confidence that the investigation will yield results of value. Probably there is no other organization as well equipped to handle this essential part of the program as is the Society acting through its Technical Divisions and in cooperation with other technical societies that cover a more specialized field. In fact, an adequate research program is necessary in order that the various committees of the Technical Divisions of the Society may successfully complete their assignments.

An Essential Service.—There are available, for the investigations here proposed, several materials laboratories with excellent equipment and well-trained personnel. Most of these offer their facilities on condition that they be reimbursed for only their actual out-of-pocket expenses. By utilizing these means, the cost of the required researches can be kept comparatively low.

An adequate research program can be continuously maintained if each member of the profession will realize his responsibility and take all possible means to support it. Not only is such a program needed to enable engineers to give better service, but it is essential to enable them to maintain and enhance their standing in the general social order.

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New York Municipal Airport

LaGuardia Field, an Up-to-the-Minute Air Terminal, Both Transcontinental and Transoceanic

By Brehon B. Somervell

Member American Society of Civil Engineers
Lieutenant-Colonel, Corps of Engineers, U.S.A.; Administrator, WPA, New York City

Fortunate indeed is the city that possesses a municipal airport combining the desirable features of commodious size, central location, easy accessibility, and joint facilities for land and sea planes. Such is LaGuardia Field. Originating in a small private field, by creative imagination it has been developed into one of the largest and most modern airports on the continent. Colonel Somervell here explains how various technical abilities were commandeered and coordinated in its planning; how 17 million cubic yards of a city ash dump on a nearby island was utilized in reclaiming its subaqueous areas; and how the main units of its huge plant were built by the WPA—all this in the short space of two and a half years. A second paper covering the operation and accessories of the airport will appear in an early issue. This paper was presented before the Waterways Division at the 1940 Annual Meeting of the Society.

New York, the largest city in the United States, has today assumed its rightful place in the field of aviation with the finest equipped, most modern, and most up-to-date airport in the country, recently officially named LaGuardia Field in honor of the Mayor of New York.

The nucleus of this new airport was a small privately owned field, known as the North Beach Airport, which was acquired by the Curtiss-Wright Corporation in 1929. In January 1935, the city leased the field, which at that time comprised 105 acres situated on the East River south of Rikers Island, on the peninsula known as Sanford Point, bounded on the west by Bowery Bay and on the east by Flushing Bay. Three small hangars stood near the shore at the northwesterly edge of the property, half hidden by a hill about 60 ft high on the east. The portion of the field available for planes was of a limited size and without runways in the modern sense. Under the city's tenure as lessee, the area was used by private plane owners and by "barn stormers" as a base for short sight-seeing trips.

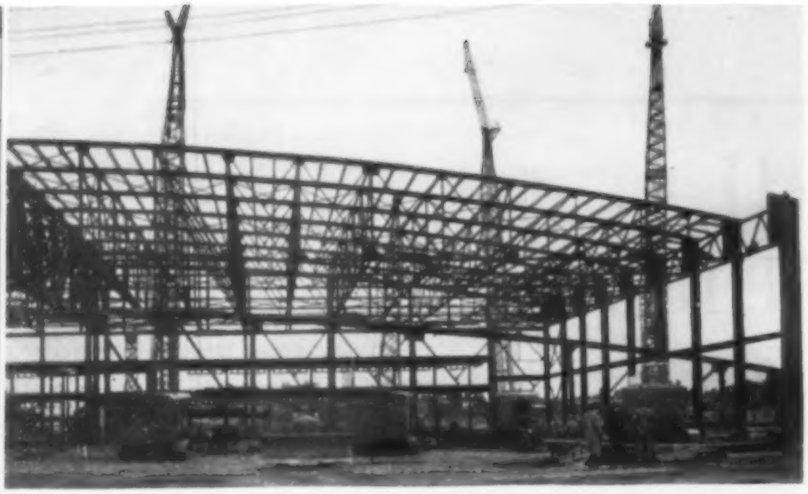
Steps were taken by the Mayor in 1937 to win the necessary approval of the city's Board of Estimate and the Sinking Fund Commission for purchasing and developing the airport and obtaining the help of the federal government, through the Works Progress Administration. Tentative plans were drawn up under the direction of the Works Progress Administrator for New York City, in cooperation with Commissioner John McKenzie of the Department of Docks. Designs for the proposed buildings were prepared by Delano and Aldrich, who were retained by the city. All work in connection with the project was to be done by the WPA except driving foundation piles, building the bulkhead, and certain other operations requiring heavy equipment. This work was done by contract.

In January 1938, New York City exercised its option and purchased the property from the Curtiss Corporation for the development of a commercial airport. It added to this property by purchasing additional land to the south and west, approximately 95 acres, and by reclaiming land from Flushing and Bowery bays and Rikers Island Channel by means of dry fill.

The site is exceptional because of its accessibility to New York City, Brooklyn, and Long Island, and by way of the new Whitestone Bridge, to Westchester and western Connecticut. As another marked advantage, it offered an opportunity for reclaiming a large area of new land from the East River and from Bowery and Flushing bays, instead of having to fit an airport to limited surroundings, handicapped by the terrain or by the nearness of tall buildings. Thus it became possible to lay out the entire airport with ample lengths for runways, giving first consideration to prevailing winds and to future expansion; and also to group the buildings on the land side, leaving the flying field clear of all encumbrances.

In laying out the airport (Fig. 1), the best experience in the country in this branch of engineering was called upon. The Bureau of Air Commerce, the U.S. Army, and the engineers of the important air lines contributed. Plans

Getting the Fill from Rikers Island
As Many as 400 Trucks and 40 Shovels Worked 24 Hours a Day



Land-Plane Hangar Under Construction
Note Use of Three 90-Ft Booms Together to Set Half-Span Truss, 172 Ft Long

were drawn by the Design Section of the WPA Division of Operations, assisted by a board of consulting engineers and architects working in conjunction with the engineering staff of the city's Dock Department, assisted by a board of consulting engineers from the Corps of Engineers and from private concerns who had designed airports in other locations. The design of the field, particularly the arrangement of runways, lighting, and signals, was also guided by specialists of the Bureau of Air Commerce, forerunner of the Civil Aeronautics Authority.

Taking advantage of the exceptional location, the city and the Works Progress Administration (later succeeded by the Works Projects Administration) have constructed a huge modern airport for the use of both land and sea planes. Approximately 60% of the airport is on made ground, and to develop this it was necessary to know the nature of the surrounding subaqueous bed to determine the amount of fill needed. Hence extensive soil borings and soundings were taken for the entire area, both on land and water, and complete topographical surveys were made. Test piles were driven on the original ground area where buildings were to be placed to determine the necessary depths and corresponding bearing values.

This combined information indicated that the entire river bed consisted of a very soft, deep muck, in some cases as deep as 80 ft. This required extreme care in filling operations to prevent excessive settlement and disastrous mud waves. The level of the airport was fixed at 12 ft above mean low water at the perimeter, and 15 ft at the front of the buildings. It was therefore estimated that an average of approximately 27 ft of fill would be required on top of the mud, inclusive of losses from displacement of the silt and settlement. Because of these losses, the estimated fill was approximately double the theoretical amount required between the river bed and grade level. Filling was done in shallow layers kept at a slope as flat as possible, which averaged approximately 1 in 35. Beyond the water line, of course, the material was allowed to take its natural slope.

Other methods, including hydraulic fill and the use of a bulkhead or cofferdam were considered, but were rejected as impracticable, as unsuited to WPA operations, or as too costly. The only bulkhead was one 1,763 ft long, of steel sheet-piling, driven along the south end of Bowery Bay, where close access to the shore for the seaplanes was desirable. Subsequently, Bowery Bay was dredged by the city, under private contract, to a depth of 15 ft. The westerly side of the airport along this bay, from the bulkhead on the south to Rikers Island Channel on the north, was filled with the heavier material from the hill to displace the muck and ensure the stability of the shore line against the effects of dredging operations and erosion.

To complete the entire development of the airport required approximately 17,000,000 cu yd of fill. Fortunately, this amount was available from the rubbish dumps located at Rikers Island directly across Rikers Island Channel from the airport site. This fill was ideal for this use as its weight of 70 lb per cu ft was considerably less than that of run-of-bank fill would have been.

To transport this rubbish to the airport site required a bridge across Rikers Island Channel. This bridge was supported on steel H-section piles driven to refusal in 80 and 40-ft lengths, spliced together as required and burned off to grade. On top of these piles was constructed a steel frame superstructure with wooden decking and checkered-tread steel plates, providing two lanes with a total width between guards of 24 ft. In the center of the channel was a movable barge to permit of navigation. This barge, 240 ft long and 40 ft wide, weighing 300 tons, was opened and closed by an electric winch handling cables fastened to pylons located at some distance on each side. This temporary structure, designed and built by the WPA, was removed by contract as soon as the filling was completed.

When the trestle was finished, the force employed by the WPA on the job was increased to 5,000 men. Floodlights were installed throughout the field and on the island, and the work was put on a 24-hour schedule, with three shifts, six days a week. When the building construction began, the personnel was again increased to over 11,000, which figure was raised gradually until, when the construction was at its height in the early months of 1939, it was over 23,000. Under the legislation then governing the WPA, prevailing hourly rates were paid, with a fixed limit to the amount that could be earned in a four-week period. This automatic restriction meant that a far larger number of men had to be assigned to the work, in shifts of a few days each, than

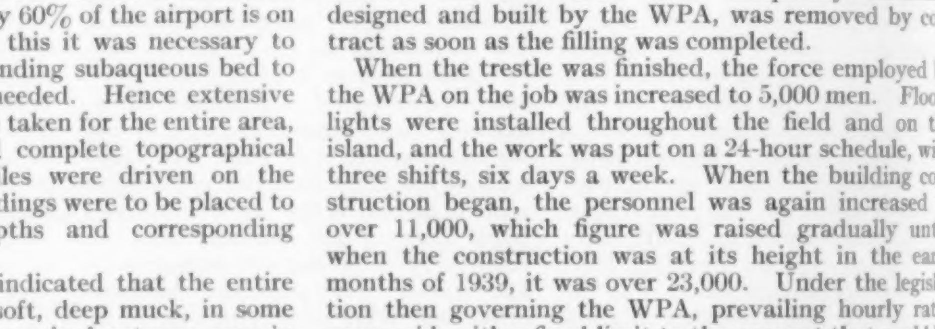


Fig. 1. Plan of La Guardia Field—Area 550 Acres

LOOKING WEST OVER THE LAND-PLANE FIELD ALONG OBSERVATION PLATFORM, WHICH ACCOMMODATES 5,000 PEOPLE

could be employed on any one day. Approximately 9,000 men were working on the job daily at the peak of operation, and about this number was continued after the appropriation act passed by Congress on June 30, 1939, fixed the hours for all workers at 130 a month.

For excavating and loading the ashes and rubbish, forty steam shovels, at the peak, served as many as 400 trucks. The great mounds of ashes on the island were cut down 15 ft at a time. Deep cuts and roads were made to several points on the island to facilitate the operation of the trucks. Haulage schedules provided for an 8-cu yd load of fill crossing the trestle every 7 seconds, 24 hours a day.

Filling of an area was started at low tide, and the area built up as the water rose. Trucks were dumped along the inner side and the material was spread by bulldozers. By the time a section had been brought up to grade by this system, it had been packed sufficiently by the trucks and tractors to be stable.

The architects who had drawn the preliminary plans, Messrs. Delano and Aldrich, of New York City, were commissioned by the city to lay out the general plan except the flying field proper, to design all the buildings, and to assume responsibility for the landscaping. It required many weeks to correlate the exacting requirements of the WPA, the various city departments, the Board of Fire Underwriters, and the air companies. The working drawings for the buildings were started at the end of December 1937. Approximately one thousand drawings were made in the course of the following 18 months, together with the accompanying specifications. These included all the complicated drawings for heating and air-conditioning, plumbing, lighting, and inter-communicating systems of telephone and pneumatic tubes. Since it would have required a year to work these out in final form, it was agreed with the WPA officials that the drawings should be supplied one after another as quickly as the necessary information could be gathered and put on paper. This called for close cooperation between the architects and the WPA Division of Operations.

To carry out the double purpose of the airport as a terminal for both transcontinental and transoceanic planes, two separate bases are provided, each with its own administration building and hangar accommodations. The two are connected by a taxi runway for planes, and by an interior road bordering the Grand Central Parkway.

There are four great runways for land planes (Fig. 1), with a surface of five-course asphalt macadam to provide for the settling of the made ground beneath them. The longest of these, No. 1, is 6,000 ft long and 200 ft wide, and runs northwest and southeast. Runway No. 2, running northeast and southwest, is 5,000 ft long and 200 ft wide; No. 3, running east and west, is 4,500 ft by 150 ft; and No. 4, running north and south, is 3,532 ft by 150 ft. In accordance with the "wind rose" diagram showing the prevailing winds at the site, the 6,000-ft runway follows the direction of the most frequently prevailing winds, the 5,000-ft runway the line of the second most frequent, and so on.

Taxi runways, 100 ft wide, intersect the main runways, connecting them with one another and with the apron, 400 ft wide and 6,200 ft long, which extends in an arc in front of the land-base building. This apron is of concrete for a length of 2,500 ft where it is on the original ground, and of the same asphalt macadam construction as the runways where it is on the newly made ground. The part of the apron in front of the loading platform is intended to provide ample space for the loading or unloading of fifteen transport planes at one time.

Elsewhere the entire ground area has been covered with top-soil and seeded. That part on the land, or parkway side, is being landscaped. The words "New York," in 85-ft letters of white crushed stone, stretch across a grass plot between the runways.

All the buildings are supported on cast-in-place concrete piles, varying in length from 35 to 125 ft. For those structures on original ground, only the columns rest on piles, but in the buildings constructed on fill, comprising the eastern group, the concrete floor as well is thus supported. A total of 9,012 of these concrete piles were placed by the city on contract. All buildings are of fireproof construction throughout, with steel frames and exteriors of a soft buff-colored face brick with black brick trim.

The administrative building overlooks a boat basin maintained by the city's Department of Parks between the southeastern part of the airport and Grand Central Parkway, and connected with Flushing Bay by a narrow channel. Between the parkway and the buildings of the land-plane base is a macadamized parking space broken by landscaped malls, and accommodating about 1,600 automobiles. The buildings of the land-plane base comprise an administration building in the center, corresponding in function to a large railroad station, and three hangars on each side arranged in an arc. The segmental arrangement was determined by the layout of the runways, by the presence of the boat basin, and by the rules of the Bureau of Air Commerce, now the Civil Aeronautics Authority.

The circular Land-Plane Administration Building has wings running both east and west, or parallel to the field. The main building is 170 ft in diameter and four stories high, surmounted by a control tower. The wings are both 70 ft long, 60 ft wide, and three stories high.

In this building are located the post office, baggage and check rooms, first aid and doctors' quarters, air express space, ticket offices, information desk, telephone and telegraph offices, cafeteria, coffee shop, restaurant, kitchens, barber shop, Port Manager's office, and offices for the Weather Bureau and Civil Aeronautics Authority,

REAR VIEW OF WEST GROUP OF LAND-PLANE HANGARS, SHOWING AUTOMOBILE PARKING AREA

Delano and Aldrich, Architects

DRAWING OF ADMINISTRATION BUILDING, LAND-PLANE BASE
Observation Platform in Front, Boat Basin in Rear

as well as a special suite for the Mayor of the City of New York. The latter has since been rented to one of the air lines for use as a clubroom.

The Air Traffic Communications and the Air Traffic Control are located on the third floor. From these offices all air traffic in the northeastern part of the United States will be handled. There is a complete pneumatic-tube service from these rooms to the loading platform.

At the parkway side of the building is a circular drive with two roadways—one, at ground level, serving the ground-floor entrance of the building and intended for the exit of passengers arriving by air; the other, on a circular ramp, leading to an upper entrance of the building at the main floor level and intended primarily for passengers about to take planes.

The control tower on the roof is a steel and copper structure, with sides sloping outward at the bottom to prevent glare, its upper part designed to shield the windows from water in a storm. It is provided with special air-conditioning apparatus to prevent condensation. On top of the tower is a 13,500,000-cp rotating beacon of the new double-end type, the most powerful beacon in the country; also the latest types of wind-velocity and direction indicators, operating seven additional sets of indicators for the control room and various air lines. A separate set is installed on the roof for the Weather Bureau, and an indicator from the main set also is installed in the Weather Bureau's offices, so that one set can be checked against the other.

Access to the planes is from a covered loading platform of steel and concrete construction, 1,500 ft long and 20 ft wide, which runs along the edge of the loading apron (Fig. 1) in a long arc between the two groups of hangars, with the administration building in the center. The field side is enclosed by steel panels with 40 swing doors or gates spaced uniformly along the platform and divided into groups of three by dispatchers' booths connected to the dispatchers' offices and ticket offices inside the building by a pneumatic-tube system and telephone. Last-minute weather and other instructions, and the final check-up of passenger tickets are handled at these booths.

Planes are brought up so that passengers can embark or disembark only a few feet from the gate. A public address system announces arrivals and departures of planes. Stairways lead down from the concourse on the main floor to this platform, and other broad stairways lead from the concourse to the concrete promenade on top of the loading platform. It is from this upper promenade that those seeing travelers off or waiting for incoming travelers may watch the field, and thousands of visitors may view the varied activity of a great airport, with a view of the field at close range and yet safely out of the way of planes, passengers, mail, and express. Five thousand persons can be accommodated on this platform at one time.

The six land-plane hangars are identical in size and appearance. Each is 350 ft wide and 165 ft deep with the bottom chords of the trusses 42 ft above the floor line. The hangars are connected so that the spaces between them may be utilized for buildings for shops, maintenance, and other purposes. On the parkway side a two-story wing, approximately 1,300 ft long and 40 ft wide, contains shop spaces on the first floor, as well as offices, kitchens, cafeteria, pilots' training facilities, pilots' and stewardesses' lounges, first-aid rooms, and so forth, divided according to the desires of the tenants.

At the end of the westerly group of hangars is a two-story wing 176 ft wide and 197 ft long, entirely used for machine shops and engine and propeller overhaul shops. This building also contains three engine test cells with control rooms for testing engines after overhaul. In back of the middle hangar of this group, a two-story office building houses the officers and personnel of the American Airlines.

All the office space, and a large proportion of the shop space in the wings of the westerly group is air-conditioned, by means of 22 units supplied from six 50-ton refrigeration compressors.

At the Marine Terminal, approximately a mile west of the main administration building, there is a circular traffic building with wings two stories high. It houses the general and ticket offices of the Pan American Airways System and any foreign air lines that may wish to use the facilities. There are also accommodations for Immigration, Health, Customs, Post Office, and the Weather Bureau—all agencies of the U.S. Government. The second floor is devoted entirely to offices.

Adjacent is the seaplane hangar, a five-sided building with hangar doors on four sides and shop and office spaces in the rear. This building is about 354 ft long and 275 ft wide, with the bottom chords of the roof trusses 45 ft above the floor. Planes will be towed into this hangar along a standard-gage marine railway extending from the building across the property to the bulkhead and then down a $3^1/_2\%$ ramp into Bowery Bay. The tracks continue into the water until they reach a depth of 12 ft below mean low water. There is also a concrete apron, 100 ft wide, around this building on four sides.

Aerial Explorations, Inc., N.Y.C.

AIR VIEW OF NEW YORK, SHOWING ACCESSIBILITY OF LA GUARDIA FIELD, WHICH IS NEAR POPULATION CENTER OF MUNICIPAL AREA

Compaction of Soils by Explosives

New Method Used Successfully to Consolidate Loose Sand Deposits at Franklin Falls Dam Site

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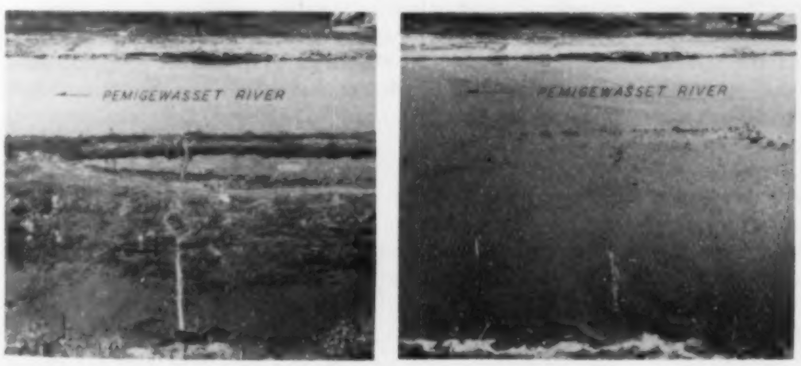
The first major application of explosives to the compaction of soils is reported here by Colonel Lyman, developer of the method. Economical and efficient, the procedure merits the careful consideration of any engineer confronted with the problem of building a structure on loose cohesionless soil. In the accompanying paper, description of the pioneer work at Franklin Falls Dam is prefaced by a discussion of soil characteristics, and a brief review of other methods of consolidation.

Loose deposits of cohesionless soils are frequently found in nature, and with a seeming perversity occur at sites which the engineer otherwise finds highly suitable for the location of structures. Erection at some alternative site may be infeasible, leaving the foundation engineer confronted with the necessity of utilizing the site in question. His treatment of the problem must be based on a consideration of the loads and stresses that will act on the soil mass and the corresponding deformations within it. He will consider several types of treatment:

1. Structural loads may be transferred to deeper and more consolidated deposits by piles or piers.
2. Spread footings, grillages, or foundation mats may reduce the unit stresses and the resulting deformations within the soil mass to the point where settlement of the structure is within tolerable limits.
3. Compaction and preconsolidation of the loose deposits of soil by artificial means before erection of the structure may result in the desired increase in bearing capacity.

Design and construction methods of types (1) and (2) are well established. Frequently, however, the result is an expensive foundation whose cost is disproportionately large compared to that of the superstructure.



Franklin Falls Dam Site, N.H., Before (Left) and After (Right) Compaction of East Terrace by Blasting

In recent years it has been realized that compaction and preconsolidation of loose foundation soils will modify their stress-strain characteristics so as to require less elaborate foundation designs. This paper briefly discusses some of the characteristics of loose soil deposits and presents a method of compaction whereby a large alluvial deposit of fine, loose, saturated sand was compacted by the detonation of buried charges of explosive.

A chief consideration governing the structural use of masses of granular cohesionless soil is the change in porosity of the materials when they are subjected to stress. Stresses are, in general, caused by three types of action: (1) gravitational loads of a static nature, consisting of the weight of a superimposed structure and of the soil mass itself; (2) hydrostatic pressures caused by ground water and by impounded water; and (3) dynamic forces.

Gravitational Loads. The gravity weight of a superimposed structure is a static load which slowly increases as construction proceeds. Settlement of the ground surface underneath the structure always occurs, and is composed of two parts—a slight elastic compression of the soil grains, and a relatively large permanent reduction in the void spaces between the soil grains. In loose cohesionless soils this decrease in porosity may cause substantial settlement of the superimposed structure; on the other hand, dense cohesionless soils can support heavy structures with insignificant settlement. The soil mechanics methods developed in recent years give an adequate analysis of the degree and rate of settlement to be expected.

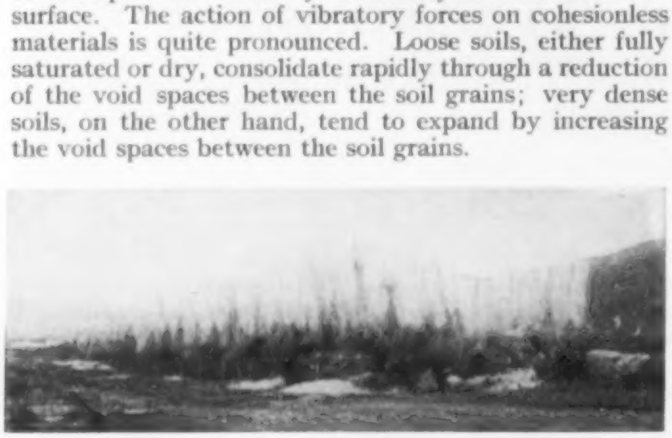
Somewhat analogous to a superimposed structural load is the weight of the material itself. Fortunately, natural deposits of granular soils are already consolidated under their own body forces; in fact, at some time in their geologic history they may have been subjected to much greater overburden loads and may have consolidated under these greater loads.

Whatever the nature of the static stresses within the soil mass, their application has been gradual and the resulting deformations have likewise been gradual. Consequently, within those portions of the soil mass that are saturated with water, there is ample time for the drainage out of the mass of the surplus pore water resulting from a reduction of the void spaces between the soil grains. High hydrostatic pressures, therefore, are not built up in the pore water.

Hydrostatic Pressures. Ground-water flow, or seepage flow from impounded water sources, is of major importance in earth masses if the flow emerges at the ground surface with a velocity sufficiently high to cause flotation and movement of the soil grains. This results in what is known as a "quicksand" condition. Earth structures that impound water are subject to hydrostatic pressure on their upstream faces. Seepage pressures within and underneath the structure itself, however, are the forces that create most danger.

Dynamic Forces. Vibrations in an earth mass may be induced by earthquake shocks, detonation of explosives,

or the operation of heavy machinery or vehicles on the surface. The action of vibratory forces on cohesionless materials is quite pronounced. Loose soils, either fully saturated or dry, consolidate rapidly through a reduction of the void spaces between the soil grains; very dense soils, on the other hand, tend to expand by increasing the void spaces between the soil grains.



TYPICAL COMPACTION BLAST AT FRANKLIN FALLS DAM SITE

The porosity at which a cohesionless soil will undergo deformation without change in void spaces has been called the "critical porosity." This value is not a constant but decreases with increasing pressure on the soil. The determination of critical porosity in the laboratory, using the tri-axial compression machine, is described in the report, "Compaction Tests and Critical Density Investigation of Cohesionless Materials for Franklin Falls Dam" (U.S. Engineer Office, Boston, Mass., April 1, 1938), and is based on research work at Harvard University.

There would be little significance to the volume changes of cohesionless soil masses due to deformation, if these soils were not frequently saturated with water by virtue of their position under the natural or artificial groundwater table or within the saturated portions of earth embankments. When a soil is in a saturated state, any tendency toward change in the void spaces, either an increase or a decrease, is reflected as either a tension or an excess pressure within the pore water.

A saturated loose soil mass, therefore, when subjected to rapid deformations, has a tendency to decrease its void spaces, simultaneously transferring stress from the solid particles of the soil to the pore water, with a corresponding decrease in the shear resistance of the mass. As a result, the vertical loads that the soil can support decrease quickly; but since the actual vertical loads are of an invariable magnitude, the soil mass is likely to fail. Failures of this nature are quite distinct from shear failures and have been called "flow failures" or "flow slides."

On the other hand, a saturated dense soil mass, when subjected to rapid deformations has a tendency to increase its void spaces. The deficiency of pore water results in a tension in the saturating water which further restrains the soil mass and permits vertical loads even greater than those which the mass is normally supporting.

For these reasons, the foundation engineer confronted with the problem of deposits of loose cohesionless soils should investigate the necessity or desirability of artificially compacting the materials before erecting the proposed structure.

COMPACTION METHODS

Pile Driving. The driving of wood or sand piles in masses of loose, cohesionless soil produces a compaction of the materials whereby the interstices between the soil grains are reduced. This action is due largely to the vibratory effect of pile driving, which causes a rearrangement of the granular structure.

Rolling. For the same reason, rolling of loose sands with heavy vibratory machines, such as the large-sized crawler-type tractors available in America, produces an effective degree of compaction to depths of several feet. The crawler-type tractor has a high degree of mobility and can cover large areas rapidly and at low cost. In the case of fills where soil can be placed in successive layers not exceeding several feet each in thickness, the progressive use of tractors and rollers for obtaining compaction generally is the most feasible method. In Europe machines weighing as much as 25 tons have given effective compaction to depths of 15 ft.

Vibration. More recently, large-size vibrators, similar in many respects to the small-size commercial concrete vibrators, have been applied to sand deposits. The author has, within the past several years, constructed two such vibratory machines—one, a heavy pneumatic surface tamper; the other, a high-frequency vibrator, electrically driven, having a tubular vibrating element which penetrates the soil to some depth. Tests conducted with these and other vibrating machines indicate that the radius of effect of the compaction produced is too limited to permit their economical and rapid application to any but very small areas.

Dynamite Compaction. For treatment of deposits of loose sand extending to moderate and deep depths, the author has developed a method of soil compaction which effectively compacts fine and medium sands, including those having an appreciable silt content. The method utilizes the shock and vibratory waves emanating from calculated charges of explosives. The latter are buried within the naturally or artificially saturated soil mass and are then detonated.

The first major application of the method of compaction of soils by the use of explosives was made at the Franklin Falls Dam site, on the Pemigewasset River in New Hampshire. The proposed dam will be a rolled earth structure about 1,700 ft long, with a maximum height of about 130 ft. Subsurface soil investigations, consisting of borings and, in the later stages, large dewatered test pits, indicated that the upper 10 to 30 ft of the flood plain forming the foundation area consisted of loose alluvial sands. These sands ranged in gradation from fine to medium and were deposited in lenses, pockets, and strata in very heterogeneous fashion varying both laterally and vertically. Some consolidation under the weight of the dam would occur progressively during construction but it was concluded that the resulting settlement would not be of major consequence. Apprehension was felt, however, as to the potential danger of sudden liquefaction of these materials under earthquake stresses after completion of the structure because the porosity of much of this deposit would be above the critical.

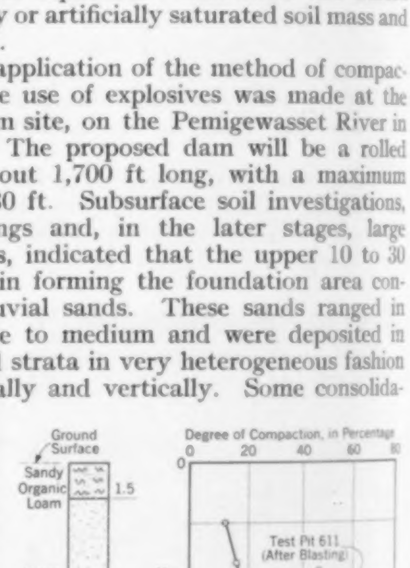


FIG. 1. DEGREE OF COMPACTION, BEFORE AND AFTER BLASTING, VS. DEPTH

"Degree of Compaction" Indicates the Compactness of the Sample in Relation to the Loosest (0%) and Most Compact (100%) States Obtainable in the Laboratory

From studies and cost estimates of various methods of compaction, it was concluded that the only feasible form of treatment then available to the engineering profession was the driving of wood piles over the dam site—an effective but expensive process. Under the direction and immediate supervision of the author, initial compaction tests using buried charges of explosives were then conducted. Ground-surface settlements of the magnitude of 6 in. resulted from individual charges. A comprehensive test program covering a much larger area was then laid out, the size and distribution of charges being governed by the spheroidal shattering surface occurring around the individual charges. The use of a large test area resulted in larger ground-surface settlements and at the same time localized any lateral displacement of soil that might be associated with the explosion of a single charge. Five successive coverages of the test area, using a staggered lateral and vertical distribution of charges, resulted in a total cumulative ground surface settlement of 2 ft, the compaction being distributed over an estimated depth of 20 ft.

Prior to the blasting operations, undisturbed soil samples were taken in the test area from an unwatered test pit. After the blasting, a similar test pit was excavated adjacent to the first one and a comparison of the two pits furnished a quantitative analysis of the results of blasting.

RESULTS OF BLASTING METHOD EVALUATED

Change in Porosity. Figure 1 shows the effects of compaction in terms of "degree of compaction," which increased on the average from 26 to 58%. At each elevation indicated in Fig. 1, a total of 6 undisturbed soil samples were taken, and a fairly uniform degree of compaction was found to extend laterally.

Change in Structure. A visual examination of the samples in the two test pits showed that the lensing, stratification, and bands of highly permeable coarse sand were thoroughly shattered by the blasting operations.

Change in Permeability. A reduction in permeability follows naturally from a reduction in the void spaces between soil grains. Laboratory tests on the foundation materials determined the permeability curves *A* and *B* shown in Fig. 2, all laboratory tests being made on remolded samples.

Field pumping tests indicated a much greater difference in permeability as a result of blasting. Identical wellpoint systems were installed around the two test pits, the one before blasting pumping 400 gpm and the one after blasting, 75 gpm. Curve *C*, therefore, can be drawn through the 75-gpm point parallel to curves *A* and *B* in Fig. 2. This indicates that the reduction in flow of 325 gpm as a result of blasting was composed of two parts—45 gpm being attributed to reduction in void spaces, and 280 gpm being the result of the breaking up of lensing and stratification of coarse deposits found in the field but not simulated in the laboratory tests.

Action of the Explosives. In all cases, the size, depth, and lateral distribution of the charges of explosive were based upon a consideration of the spheroidal shattering surface around an individual charge. The charge should be sufficient to fracture the surface of the ground without forming craters. Within a mass of saturated soil, the initial instantaneous reaction of a charge is the formation of a spheroidal cavity full of gases under pressure. At the same time, the shock and the vibratory wave from the explosion rearrange the grains of the soil into a more compact structure, the surplus pore water causing a liquefaction of the mass. The ball of gas is then squeezed out to the surface and the lateral flow of soil seals the

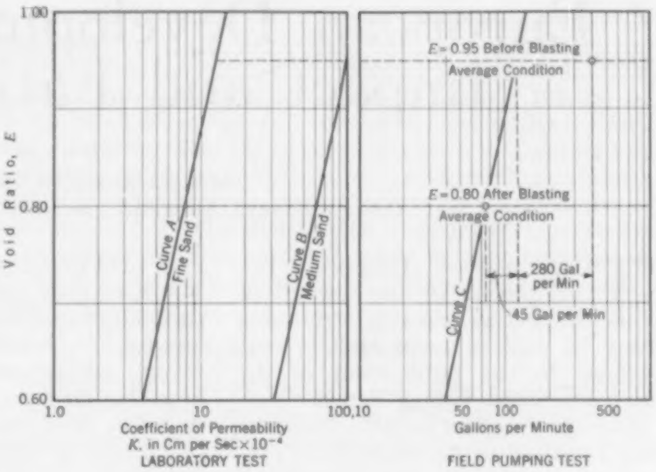


FIG. 2. PERMEABILITY VS. VOID RATIO

cavity created by the explosion. Test pits extending to the former location of charges have revealed no traces of cavities.

Within a few minutes after a blast, small boils and geysers of water break out over the area—a typical "quicksand" condition. The liquefied soil mass bleeds surplus pore water for periods as long as 30 minutes, during which time it settles and rearranges its grain structure. When the pore-water pressures have receded, the entire weight of the mass is carried by the grain structure of the soil. In this state, the soil is more compact than before blasting and has greater bearing capacity. Successive blasting over the same area again liquefies and further settles the mass, but the amount of surplus pore water escaping to the surface and the amount of ground-surface settlement progressively decrease.

Subsequent to this test work, a large portion of the foundation area at the Franklin Falls Dam site, consisting of two overbank flood plains each approximately 400 by 850 ft in size, was compacted in this fashion by detonation of buried charges of explosives. The results were more effective than the above-described test program indicates, because of the interacting effect of blasting simultaneously over a much larger area.

OTHER APPLICATIONS OF THE METHOD

The action of explosives on loose soils has also been studied in connection with hydraulic fills. On the Cape Cod Canal, a previously completed hydraulic-fill dike, consisting in the main of cohesionless fine sand, was treated by detonating buried charges of explosives. The visual results apparent on the ground surface were, in general, the same as at the Franklin Falls Dam site. The quantitative degree of compaction, however, was not determined from test pits.

In another case, test borings at a proposed dam site in western New York State revealed a deposit of fine sand overlain by a moderately thick deposit of coarse gravel. The initial density of this sand deposit could not be determined by a deep test pit because of the impracticability of unwatering the deposit of gravel. It was suspected, however, that the overburden of this and other geological periods had consolidated the sand deposit to a suitably high degree of density, so that the dam structure could be safely superimposed thereon. Deep charges of dynamite were cored down and detonated. Although a severe shock was given the foundation area, no settlement of the ground surface occurred, and the geologist's opinion as to the density of the sand deposit appeared to be confirmed.

European Developments in the Study of Impact and Fatigue in Structures

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A CONCISE review of European research and practice in regard to impact and fatigue in structures is presented here by Mr. Frankland, together with a selected bibliography for those who wish to pursue the topic in more detail. The paper is from the Structural Division program at the 1940 Annual Meeting.

THE marked European development in the theory of impact as affecting structures may be said to have had its real genesis in the publication of the Report of the Bridge Stress Committee in England in 1928,[1] describing its experimental work of the preceding five years. Appointment of this committee, in turn, had been brought about by many discussions in engineering publications[2] and in the Institution of Civil Engineers,[3] expressing widely divergent views on the subject of impact, following the publication in 1910 of results of the American Railway Engineering Association's experiments.

Among the important information brought out by the work of the British Committee was that "No formula can be valid which treats the whole of the impact effect in a bridge of given span as being proportional to the live load." In other words: For bridges, the idea of an impact factor, greater than unity, by which the amount of the moving load should be multiplied in order to take account of impact effect, does not correspond with the facts. In long-span bridges, where the effects of impact can be submitted to fairly complete analysis, it leads to results that are obviously incorrect. In short-span bridges, for which the analysis is less complete, treatment is more empirical and rough methods of estimation had been used. The Bridge Stress Committee investigated the following problems:

1. The establishment of a relation between the pulsating forces exerted by a fast-traveling locomotive and the resulting oscillation and stresses in the bridge.
2. The measurement of stresses and deflections due to the dynamic action of moving loads, unrelated to the effect of hammer-blow.
3. The expression of the probable impact effect on bridges in a form suitable for general use by designers, either by means of a formula or otherwise.
4. The investigation of locomotive characteristics, and the possibility of modifying their design, with a view to reducing impact effects.

As a result of its voluminous research, the committee offered recommendations for the design of railway bridges in the form of tables and graphs for equivalent uniformly distributed loads to cover definite stated allowances for impact, and an explanation of the mathematical theory upon which the tables were computed. These rules recognize and take care of the misconception that had arisen from false analogy to the dynamic effect of suddenly attaching a heavy mass to an elastic support. When a weight is fastened to an unloaded spiral spring and then suddenly released, the spring will stretch to nearly twice its static extension for the same load; under such conditions the impact effect is proportional to the load, and the combined effect of live load and impact can be found by the use of a multiplying factor of about 2. It had been assumed by some that the quick passage of a train across a railroad bridge would result in an effect of the same kind, but this supposition was disproved by the investigations of Professor Inglis.[4]

The information developed by the committee demonstrated that bridge damping depends not merely on the span length, but also on the general character of the bridge and the type of track used.

Dr. H. Kulka gave a lecture before the German Association of Steel Construction in 1929[5] in which he contended that the dynamic problems of bridge construction fall into two main groups, one treating of the bridge solely as a structure, and the other concerning itself with materials. He pointed out that "if a bridge be considered as an elastic body and if it be stressed by the application of a force, which force is suddenly removed, there occurs a transformation of potential into kinetic energy. The bridge then falls into a state of vibration and, if friction and various other influences were not present, it would continue to vibrate indefinitely. The modifying influences referred to, however, bring this condition to an end. This is what is known as free vibration, and in its pure form can hardly occur in bridge structures. The vibrations in a bridge are produced by a great number of impulses, some occurring regularly, some irregularly, as the unbalanced effect of driving wheel counterweights, tractive reactions, incomplete absorption of impact in the rails, sway of rolling stock, etc. The so-called forced vibrations arise from these latter causes.

"There is a particular kind of forced vibration which is of particular significance for practical purposes. When the frequency of the free vibrations is a simple multiple of the frequency of impact (when there is resonance) the effects on the structure may be extraordinarily great.

"The mathematical study of this last-mentioned state of vibration shows that after the lapse of infinite time, the amplitude of the vibrations, even with quite small impulses, becomes infinite, and must lead to failure. In railroad bridges resonant vibrations have been comparatively seldom observed, but they are frequently encountered in highway bridges, especially when heavy vehicles are crossing and producing rhythmic recurrent shocks."

A. Bühler, chief bridge engineer of the Swiss Associated Railroads, succeeded in 1928–1929 in developing a simple and convenient formula by which it is possible to derive satisfactory figures for the period of vibration—at any rate, an approximation as close as might be expected in such a difficult problem.[6]

Friedrich Bleich, in 1924, had offered a study of the impact problem[7] and incorporated the problem quite extensively in his treatment of alternating stresses at a later date.[8] The investigations of Bühler and Bleich had preceded an investigation of the Impact Effects in Steel Railroad Bridges by Prof. D. Mendizabal of Madrid,[9] and by the paper of Professor Streletzky of Moscow, "The Impact from Cars on Bridges."[10] Dr. G. Reutlinger of Darmstadt presented in 1932 the results of his dynamic research testing of bridges and other structures.[11]

Pippard and Baker summed up the work of the British Bridge Stress Committee in 1936[12] thus: "When a train crosses a bridge there is a certain amount of vibration due to the sudden application of load; irregularities in track and rail joints also cause impact effects which are irregular and incalculable. These, however, were found by the committee to be completely overwhelmed by another cause of vibration. The driving wheels of a locomotive are balanced for the inertia effects of the reciprocating parts, and the centrifugal effect of these revolving balance weights causes the pressure of the wheel on the rail to undergo a periodic vibration. The considerable amount of experimental data obtained by the Bridge Stress Committee from tests on actual bridges have shown that applications of the mathematical analysis lead to very accurate estimates of the true values of the stresses produced by vibration."

This analysis is too long to be reproduced here, and Professor Inglis' book should be consulted.[13]

Dr.-Ing. Krabbe of Munich gave a lecture before a meeting of the German Association of Steel Construction in October 1938, wherein he reported on a joint investigation by the Association, the German Government, and the German State Railways, and presented a discussion of the correct impact values for steel bridges. The work of this joint committee resulted in the formulation in 1934 of a Specification for Impact in Railroad Bridges by the German State Railways. These specifications embrace the latest European theory and practice and may be summarized thus:

Live-load moments, shears, and axial forces are to be multiplied by an impact factor, ρ, the value of which depends upon type of track and span length. This factor is specified for bridges with open track and also for ballasted track. The value of l in the equations varies: for main girders or trusses of single-track bridges, it is the span length; for those of double-track bridges, twice the span length; for stringers, the distance center to center of the floor beams; for floor beams, the distance center to center of main girders or trusses; and for fixed arches, three-fourths of the span length. These impact factor values apply only to bridges with welded rail splices, or with no rail splices, as now specified for all new bridges in Germany.

The German Government also published in 1933, specifications for impact in highway bridges, DIN 1073, whereby the values of l are as specified for railroad bridges and the impact factors are tabulated and given for various values of l. These specifications provide no impact for abutments, piers, foundations, or soil pressures. A consideration of American and European developments indicates that, for impact, the trend is toward similarity of treatment.

STUDIES OF FATIGUE IN STRUCTURES

The development of information relative to fatigue in steel used for bridge construction in Europe during the past decade has been almost entirely due to the building of welded structures; therefore this development is closely parallel to that in this country.

In discussion of a paper [14] by A. Bühler, chief engineer of the Swiss Associated Railways, Dr. Kommeral of Berlin stated in 1928 that "there is surely a great difference whether a member is exposed to uninterrupted alternating stress or whether it is allowed to rest between loadings." He pointed out the ease and simplicity of using coefficients in dealing with dynamic effects due to secondary stresses and irregularities of material, but stated that it was of fundamental importance to investigate to what extent an adequate account of all the individual influences of dynamic loads on bridges is necessary.

This paper and discussion marked the beginning of a series of discussions and research in Europe related to the matters of impact and fatigue in steel bridges. The Swiss Railways had for many years been conducting experiments on dynamic deflections under traffic at various speeds in actual service, but mainly with the idea of impact in mind.[15] The British Report of the Bridge Stress Committee, 1928, is confined solely to matters related to impact, and the question of fatigue is rather summarily discussed.

GERMAN AND BRITISH FATIQUE TESTS

Shortly after the publication of Bühler's paper,[14] the Materials Testing Station of the Stuttgart Technische Hochschule, under the direction of Prof. O. Graf, with the support of the German State Railways and the German Association of Steel Construction, carried out from 1928 to 1932 an extensive research on the strength of riveted and welded joints under stress repetition. This test program is described by Ing. K. Schaechterle.[16]

At this time Schulz and Buchholtz presented a paper,[17] before the International Association for Bridge and Structural Engineering, that discussed in detail fatigue tests on structural material, and stressed the importance of recognizing the fatigue effects of vibratory stressing about some constant stress (pulsating stress). The fatigue effects of mill scale, of holes, and of notches is discussed. This paper compares fatigue effects on the strength of riveted and welded joints, and undoubtedly must be considered as an outstanding contribution to the subject.

In 1934 the German Committee on Steel Testing initiated a series of tests to determine the influence of load frequency on riveted and welded connections subjected to repetitive loads. These tests, reported on by Dr. O. Graf,[18,19] showed that the length of periods of loading and no loading usually lie between the limits chosen—as shown in the table accompanying Dr. Graf's report on tests to determine the influence of load-frequency on riveted connections subjected to repetitive loads.[18]

Dr. Bühler presented a report[20] in 1938 descriptive of a series of tests on the fatigue strength of rolled beams, from which it is seen that the stress concentrations caused by notches have much more influence on the fatigue strength than do the internal stresses created by welding or rolling. About the same time, the German Steel Committee sponsored a series of tests on the stress distribution and yield phenomena under load in beams with specially stiff welded, and welded and bolted, column connections. A translation of a report covering these tests is available.[21]

On March 30, 1939, Profs. B. P. Haigh and T. S. Robertson presented a paper[22] before the Institution of Naval Architects on fatigue in structural steel plates with riveted or welded joints, describing experiments carried out on the subject by the Engineering Laboratory of the Royal Naval College, Greenwich. The authors point out that twenty-five years ago it was commonly accepted that the "limiting fatigue stress that can be applied and reversed for, say, 10 million cycles without causing fracture, must almost necessarily bear some close relation to the 'elastic limit' or 'proportional limit' given by an extensometer in an ordinary tensile test." The misleading character of such generalizations was demonstrated in the pilot tests described by the authors. In a certain air-hardening steel, for instance, the tensile proportional limit was so low that it was difficult to

measure, but the fatigue strength was found to be nearly one-half of the ultimate tensile strength. It would therefore appear that the extensometer in a tensile test provides no effective indication of the resistance of a steel to fatigue failures.

These tests demonstrated that, in regard to fatigue tests on riveted connections: (*a*) When the rivets are tight enough to resist slip and are of ordinary proportions, fracture occurs by the plate cracking from the ends of the transverse diameter of the rivet hole, and the limiting range of load is relatively low, so that high factors of safety are required to avoid cracking. (*b*) When the rivets slip even slightly under reversing loads, greater ranges of load are required to produce the same type of fracture, and the rivets are likely to crack under the heads or at mid-length. (*c*) The rivet-size formula, $D = T + 1/8$ in., gives a well-balanced design as regards resistance to fatigue as well as to steady stresses.

As regards fatigue in welded joints in structural steel, the tests show that: (*a*) If the steel is unsuitable for welding under the conditions used, such as caused by too-high carbon or other elements, or too massive or too cold to suit the small arc that may have been used, or if the electrode covering has produced an unsuitable layer of slag that has not effectively "jacketed" the hot metal, then the weld deposit or the immediately adjacent base metal may start brittle cracks while still at high temperature. (*b*) If the weld metal and base metal survive this stage of cooling without injury, either may crack at a later stage of cooling and contraction after the exterior surface has become relatively cool and rigid. Preheating and retarded cooling are beneficial when the base material is relatively thick.

The authors point out that high fatigue limits are usually associated with low carbon and manganese, and note that deposits of weld metal with these characteristics are usually of ample tensile strength "as deposited" to suit the full tensile strength of the base metal in plates of reasonable tensile strength. Such welds do not appear to require stress-relieving or annealing, and are likely to lose much of their tensile strength if normalized.

SWISS RAILWAYS TESTS ON WELDED TRUSSES

The Swiss Associated Railways reported in 1936 on a program of fatigue tests on welded trusses carried out by them.[23] This report states that the safety factor of the truss specimen (a large-scale model about 19 ft long and 5 ft deep) when subjected to fatigue stresses, was found equal to 1—that is, the ultimate load equaled the useful load. This was due to the high internal stresses and to the uneven distribution of forces. The tests demonstrated that fractures always start in the base metal (in tension) in the transition zone and occur suddenly without noticeable prior signs or changes. This feature may be useful because the structure remains apparently intact up to the moment of fracture; but, on the other hand, even a thorough examination will not show that the structure is unsound, even immediately before the failure. It is pointed out that no possible way of ascertaining the actual condition of the structure at any specified time has yet been developed, and the warning is given that the greatest caution should therefore be exercised in using welded structures when they are subject to fatigue.

In these tests truss specimens with web members connected directly to chords proved much inferior to those with gusset plates, and the use of gusset plates was recommended.

The German bridge specifications previously referred to provide that members in riveted railroad bridges subject to variable stresses tending to produce fatigue shall be designed according to the so-called γ-method used in these specifications, as applicable to main girders or trusses and floor beams, but not to stringers or bracing. As covering fatigue in welded railroad bridges, these specifications provide that all stresses, both in members and in connections, be referred to the basic allowable unit stresses. This is achieved by the use of the previously mentioned γ-factors, similar to, but somewhat different from those used for riveted construction, and also so-called α-factors, depending upon location of section and type of stress, and upon location and kind of welds, whether butt or fillet, machined or not machined, and so forth. The German specifications state that, as maximum design stresses occur but rarely in highway bridges, the fatigue stresses are usually much less. Fatigue effects therefore, as a rule, need not be considered in highway bridges. Whether highway bridges carrying electric traction lines should be dealt with as welded railroad bridges is left to the governing authority to decide in each case.

It is to be seen that the interest in, and development of, data on fatigue in steel bridge structures in Europe is of a comparatively recent date, and almost parallel to the development in this country. As a result, American and European practices are tending toward coincident and similar trends.

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Gelatin Models for Photoelastic Analysis of Stress in Earth Masses

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The practical application of photoelasticity to the analysis of stress in soils has come largely in the past five years. In many instances no other rational tool is available to the engineer who is confronted with a problem involving earth pressure or earth stability. It is, however, a tool that can be misused; and the development of technique by trial and error is a slow process. The present paper, therefore, is an attempt to provide engineers with a record of experimental difficulties encountered in an extensive test program of this nature, and the procedures that were evolved in answer to these difficulties. It was on the program of the Soil Mechanics Division at the 1939 Annual Convention.

Most work in soil mechanics is concerned, at least indirectly, either with the distribution of stress in an earth mass or with the behavior of the soil under the imposed stress. The first part of the problem, stress distribution, is the more difficult one. It has generally been necessary to assume that the earth acts as an elastic solid, and the equations of Boussinesq, based upon this assumption, have found wide acceptance where loading conditions correspond to those of the available solutions. One important restriction on the still more general use of these equations is the basic assumption of a semi-infinite solid, common to the Boussinesq-type formulas, which precludes their application to such important cases as stress in an embankment, in the earth on either side of a cut, or in the regions around a shaft or a non-circular tunnel.

Thus when the photoelastic method was introduced for other problems in stress analysis, the possibility of its application to soil problems was quickly appreciated. A bulletin published in 1929 by Prof. W. S. Housel, Assoc. M. Am. Soc. C.E., used photoelastic patterns to illustrate stress distribution under footings, and the valuable 1932 Progress Report of the Special Committee on Earths and Foundations (Proceedings, Am. Soc. C.E., May 1933, p. 814) included a number of stress patterns where bakelite was used for the photoelastic material. In general, however, the common photoelastic materials are subject to the same limitations as the Boussinesq formulas—principally in that the stress observed is that caused by an externally applied load, whereas in soil (except near the surface) the principal source of stress is the weight of the material itself. Glass, celluloid, and bakelite are all too insensitive photoelastically to show stress patterns set up by body weight in models of practical size.

Various Projects Have Made Use of Gelatin Models

By far the most sensitive material is gelatin, the use of which was precluded in earlier photoelastic investigations because it was too sensitive and too weak for the work attempted at that time. Its value for studies where body weight is a factor led to its adoption by Prof. F. L. Plummer, M. Am. Soc. C.E., in some studies of gravity dams. The most extensive use of gelatin in earth-dam studies has probably been made by Army Engineers at Zanesville and Fort Peck.

At the University of Washington gelatin was first used for preliminary studies of the design of the Ruby Dam, undertaken by Prof. F. C. Smith, Assoc. M. Am. Soc. C.E., and the authors, at the request of the Seattle City Light Department in 1937. In 1938 some soil studies were made at the university for the approach tunnel of the Lake Washington pontoon bridge, which led to the recommendation of photoelastic analysis of stress in the soil surrounding the tunnel. The recommendation was followed, and during the following year the authors of the present paper undertook the problem for the Washington State Highway Department. The apparatus was designed with a view to its use for study of stress in earth slopes as well as around tunnels.

The experience of the authors in this work has been to them convincing evidence of the value of the photoelastic approach in problems of stress in earth masses. It has also pointed to the need of more reference material for the engineer who is confronted with the task of setting up equipment and developing a technique for the solution of some specific problem by this method. The present paper is an attempt by the authors to make available to others the results of some months of work with gelatin, in the belief that such information is at least equal in value to the actual objectives of the research.

Apparatus Employed in Authors' Tests

Since the present studies at the University of Washington had their roots in the work undertaken on the Ruby Dam model, it is desirable to discuss the present apparatus with a knowledge of what preceded it. For the 1937 tests a carbon arc was first used as a source of white light, with a No. 5 Corning filter for a monochromatic light source, because the various colored bands in the stress pattern became indistinguishable at relatively low intensities of stress, whereas black and white bands were readily distinguishable through a large number of cycles. The light source was placed at the focus of a 36-in.-diameter parabolic reflector, which served to produce parallel light. The light beam was polarized by reflection from a 40 by 42-in. black glass plate. The gelatin model of the dam was 3 in. thick, and was confined between glass plates. The analyzer was composed of a pile of ten sheets of plate glass, 20 by 40 in. in size.

In this type of apparatus it is especially important to get parallel light, as the non-parallel rays will not be polarized. Completely parallel light can be obtained by a point source exactly at the focus of a perfectly parabolic reflector. Neither a carbon arc nor a 1,000-w filament bulb satisfactorily approximated a point source. Moreover, since only the reflected light was parallel, the back of the source had to be shielded. As the focus was rather short, the path of the reflected light included it, and so the shield left a dark spot in the light field.

The present light source is a commercially available projector with a 100-w high-intensity mercury lamp

producing nearly monochromatic light. The monochromatic nature of the light is improved by a filter. This lighting element approaches a point source more closely than the previously used devices. For most purposes simplicity makes it advantageous to place the color filter at the camera end of the optical bench. On the other hand, especially for preliminary tests, it is desirable that the filter be placed near the light source so that a monochromatic field is available for direct observation of the model. With the latter setup, a water-cooled heat filter was found essential to prevent cracking the color filter. On the whole this setup is quite satisfactory in conjunction with a suitable lens system. It has the disadvantage that the illuminated field is but 10 in. in diameter. Any appreciable increase in this dimension in this type of setup would involve considerable expense in optical equipment.

The limitations of size of field were especially felt when it was desired to study shear in earth slopes. At the present time another light source is being constructed, consisting of a mercury vapor lamp made of capillary tubing. The new reflector is a chromium plated sheet of steel, the horizontal cross section of which is parabolic. The line source of light will be mounted vertically, passing through the focus of the parabola. This will result in rays parallel with respect to the horizontal plane but diverging vertically. The vertically irrelevant light is to be absorbed by a number of horizontal metal plates finished in dull black.

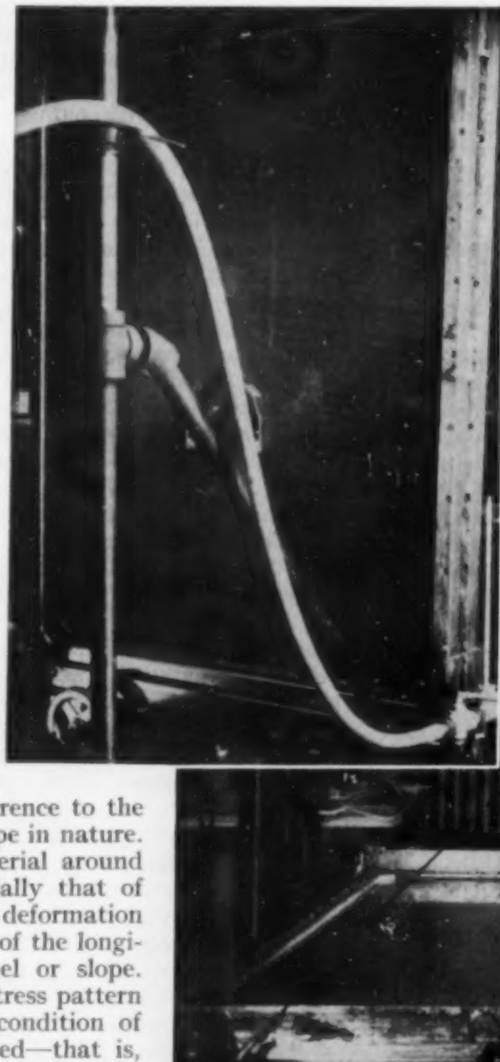
The polarizer is a 10-in. disk of polaroid. A 10-in. quarter-wave plate is next to the polarizer.

Since photographic records were to be kept of all tests, it was unnecessary to go to the expense of providing an analyzer and a second quarter-wave plate of the same diameter as the polarizer. Instead, a $2^1/_2$-in. diameter analyzer and quarter-wave plate were mounted on the optical axis next to the camera lens. Separate small analyzers, also of polaroid, were used in the hand for viewing the model during tests.

The design of the model was based upon the closest practical adherence to the conditions of the prototype in nature. The condition of the material around a long tunnel is essentially that of plane strain—that is, no deformation is possible in the direction of the longitudinal axis of the tunnel or slope. Now it is true that some stress pattern would be obtained if a condition of plane stress were simulated—that is, if there were no restraint in the direction normal to the plane of the model. It would, however, take a very thick and very stiff gelatin model to stand up without lateral support; the amount of gelatin required would be prohibitive; and opacity would be a serious factor. Hence, to simulate a condition of plane strain, it was essential that the lateral restraint be substantially complete. It was recognized that a moderate, uniform, lateral displacement might not be important, but it was also apparent that non-uniform lateral displacement would seriously affect the stress pattern.

IMPORTANCE OF USING THICK SHEETS OF GLASS

The last statement requires some further discussion, because it seems likely that it has not always been recognized in similar investigations elsewhere. If we have a sheet of gelatin between two lubricated glass plates, and restrained on the sides and bottom as well, and if the two glass plates are pushed together some equal amount at all points, then the vertical component of normal stress at a point is unchanged (being equal to the weight of the overlying gelatin), because the vertical deformation of the gelatin is unhindered and there is still zero pressure on the top of the gelatin sheet. But lateral deformation is prevented by the rigid sides of the confining frame, so that for a plain sheet of gelatin the vertical pressure is constant while the lateral pressure varies. It follows that the shearing stress in the transverse plane has also changed, being proportional to the difference between the principal stresses. Now if calibration is carried on under similar conditions, the results of the tests will be valid, because the measuring stick and the object measured have both changed in proportional amounts. On the other hand, if the glass plates are pushed together (or bulged outward) varying amounts at various loca-



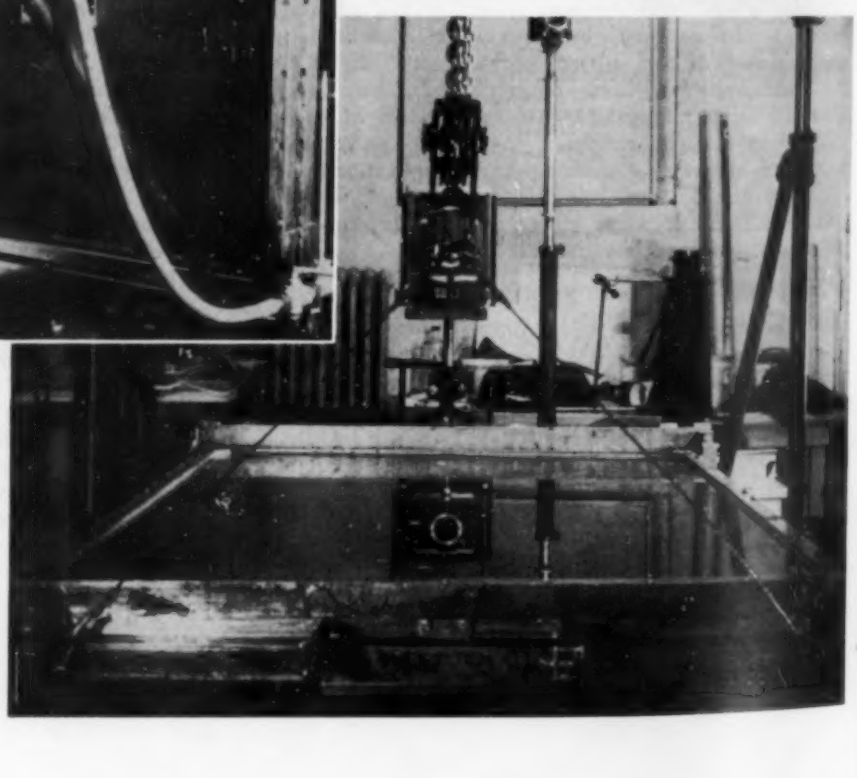


FIG. 1. THE MODEL SETUP

Left: Model in Place for Test (Tunnel Section Is near Center of Frame, Partly Obscured by Pipe and Hose)

Below: Model in Horizontal Position, Showing Arrangement of Hoisting Device and Cameras (Large Camera in Center Records Test Pattern; Small Camera at Top Records Calibration Pattern)

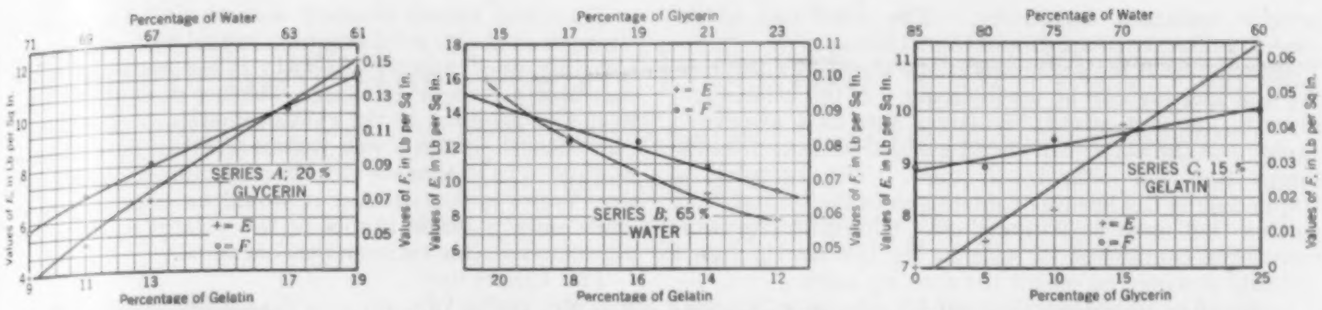


Fig. 2. Modulus of Elasticity and Photoelastic Constant of Gelatin Mixes with Various Proportions of Gelatin, Glycerin, and Water

tions, then a different measuring stick is needed at each location, and that is not possible in practice. Consequently it seems evident that photoelastic tests on gelatin cast between thin sheets of glass cannot produce valid results.

To make the confining sheets of glass completely inflexible is obviously impossible. Our present setup attempts to approach that requirement by using plate glass $^3/_4$ in. thick, 32 by 42 in. in size, held in a heavy welded steel frame (Fig. 1). The separation of the steel frames was controlled by bolting them against accurately machined steel separator blocks. The desirability of some such degree of refinement was easily demonstrated during the tests, when by loosening the bolts on one side of the frame the stress distribution could be measurably distorted. The degree of success attained by the effort to achieve an inflexible boundary is less readily determined, since a central deflection of the glass plate would still permit the formation of a symmetrical pattern. This matter is now under investigation.

RELATIVE MERITS OF HORIZONTAL AND VERTICAL COOLING

The next consideration in the design of the model frame was the position of the gelatin while solidifying. If the sheet of gelatin cooled in a vertical position, the stress at any point would be hydrostatic—that is, the vertical and horizontal pressures would be equal. If the gelatin were raised to a vertical position after cooling, then (for a uniform, solid sheet of gelatin) the lateral pressures would be a fraction of the vertical pressure, depending upon Poisson's ratio. Horizontal cooling would appear to come closer to simulating the condition of the solid deposits. Actually, however, the distinction did not prove important in these tests, as no fringes were visible in a solid, horizontally cooled sheet of gelatin when swung into a vertical position. Apparently Poisson's ratio must have been close to $^1/_2$ in this instance. Mainly because the practice of allowing the gelatin to solidify in a horizontal position minimized the danger of leakage, horizontal cooling was adopted. (The pours were made with the frame vertical, however, to facilitate the escape of air.) To permit this procedure the entire assembly has to rotate about its base on a horizontal axis.

The next requirement influencing design was that of frictionless contact between gelatin and glass. The practice of warming the glass by applying warm wet cloths had been used in the earlier investigations, but was unsatisfactory because it permitted no positive control, and because melting the face of the gelatin must affect the adjacent body of gelatin as well. As any other scheme for providing frictionless contact would require exposing the face of the gelatin for lubrication, it was decided that the frame holding each glass sheet should be hinged. The lubricating method finally adopted will be discussed later.

Although gelatin has been used considerably in recent years, there is not much published information on proportioning and handling. Commercially available gelatin powders differ mainly in the clarity of the resulting solution. The choice was made on the basis of visual inspection of a number of small samples. Subsequently an investigation of different products was carried on in which translucency was measured with a photronic cell, and strength was rated by a penetration test.

PROPORTIONING THE GELATIN MIX

Of greater importance was the proper mix. It had previously been found that the addition of glycerin contributed to both the life and the strength of gelatin mixes. To select a proper combination of gelatin, glycerin, and water, a number of trial batches were prepared. The governing properties were translucency, modulus of elasticity, and the photoelastic constant, F, which is the increment of shearing stress corresponding to each additional fringe or black band.

Test prisms 4 in. high and 3 in. square were poured with varying proportions of the three ingredients, five to a batch. Each specimen in turn was tested in compression while in the polariscope. The test method was to place the sample on one pan of a 2-kg-capacity balance with an elongated arm to increase the sensitivity. The prism was capped with a square aluminum bearing plate, topped by a centered steel ball which bore against a rigidly clamped micrometer head. Load was applied in increments of 250 grams on the other pan of the balance, and deformation measured by turning the micrometer until the balance arm returned to zero reading. Except for initial irregularities, the value of E was found to be essentially constant for any one specimen.

Values of E and F for mixes of various proportions are shown in Fig. 2.

When the investigation was made, the importance of time effects on both E and F was not fully appreciated, and not rigidly controlled; hence the results obtained are qualitative in nature, and series A, B, and C must be considered individually, not together. From the result of these tests it was decided to use a mix of 16% gelatin, 25% glycerin, and 59% water, by weight, in the first tunnel tests. With these proportions it was decided that a sheet of gelatin $1^1/_2$ in. thick would

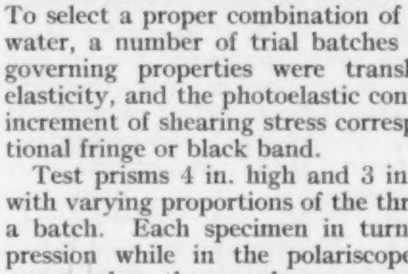


Fig. 3. Typical Photographic Record of Calibration Test

Black Bands Are Loci of Points of Constant Maximum Shearing Stress

provide sufficient sensitivity. The sensitivity of the model is directly proportional to its thickness.

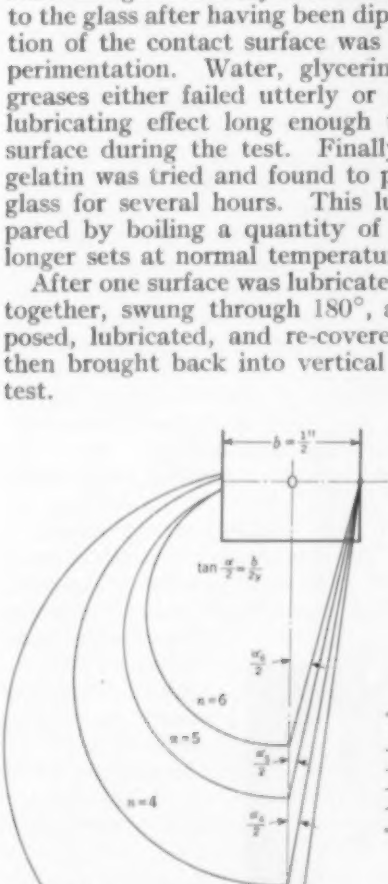
In using such high concentrations of gelatin, the mixing and melting can be troublesome. If the gelatin and glycerin are first mixed, the latter acts as a dispersing agent, and the water can then be added without forming lumps that are difficult to melt. The presence of trapped air in the mixture contributes to the formation of a scum that must be skimmed off. This difficulty could have been minimized by evacuating the air through a suitably designed cover for the cooking kettle.

Experience indicated that 40 C was a satisfactory temperature at which to pour. At that temperature flow lines were clearly visible. The gelatin could be melted and used over again six or eight times before it became inert, and its life could probably have been greatly prolonged by the addition of "Dowacide" or beta naphthol to prevent the growth of bacteria.

FREEING THE MOLD AND LUBRICATING THE MODEL

Ninety-five pounds of gelatin mix were required to fill the mold for each test run. When completely filled the assembly was laid in a horizontal position until ready to test (usually for about 48 hours). Then one glass side was unbolted and raised to permit lubrication of the contact surface. The two main problems in testing were freeing the glass and lubrication. An application of automobile wax to the glass before pouring was helpful in the former respect, although it was found that the weaker gelatin could be more readily freed from the glass if a layer of cellophane was first pressed to the glass after having been dipped in water. Lubrication of the contact surface was the object of much experimentation. Water, glycerin, and various oils and greases either failed utterly or did not maintain their lubricating effect long enough to assure a frictionless surface during the test. Finally some old hydrolyzed gelatin was tried and found to prevent adhesion to the glass for several hours. This lubricant is readily prepared by boiling a quantity of old gelatin until it no longer sets at normal temperatures.

After one surface was lubricated, the frame was bolted together, swung through 180°, and the other face exposed, lubricated, and re-covered. The assembly was then brought back into vertical position ready for the test.



$$\tau_{max.} = \frac{P \sin \alpha}{\pi}$$

$$\tau_{max.} = Fn$$

$$F = \frac{P \sin \alpha}{\pi n}$$

n	$\tan \frac{\alpha}{2}$	α	$\sin \alpha$	$\frac{\sin \alpha}{n}$
3	0.135	15°24′	0.266	0.089
4	0.179	20°14′	0.346	0.087
5	0.227	25°36′	0.432	0.086
6	0.270	30°16′	0.504	0.084

$P = 2.67$ Lb per Sq In.

$\frac{P}{\pi} = 0.850$

Average $\frac{\sin \alpha}{n} = 0.086$

$F = (0.85)(0.086) = 0.071$ Lb per Sq In.

FIG. 4. CALIBRATION: OBSERVED DATA AND COMPUTATIONS

The chief tunnel problem was to find the shearing stress in an elastic solid around a tunnel with and without a rigidly lined invert. As twin tubes were planned, it was first necessary to decide whether or not two bores would be required in the gelatin model. A preliminary photoelastic analysis was therefore made on a sheet of marblette to determine the effect of tunnel spacing, and the results indicated that it would be necessary to include only a single tunnel in the gelatin model. This permitted a scale ratio of 1 to 72.

The tunnel lining was made of $^1/_8$-in. aluminum, bent to the shape of the prototype and provided both with a flat invert lining and an arched invert lining. The model was poured with the lining, including invert, in place. Provision was made to allow the gelatin to fill the tunnel cavity. After the gelatin had hardened, the tunnel was excavated and the invert lining (except in certain cases) removed before starting the test. It was found necessary to drill a hole through the glass to permit the relief of air pressure that otherwise built up in the tunnel cavity, preventing the full development of shear in the neighboring zones.

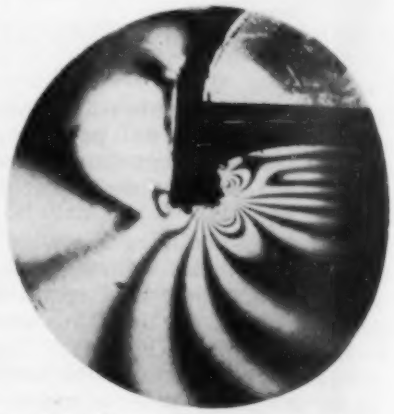


FIG. 5. CHARACTERISTIC SHEAR-DISTRIBUTION PATTERN AROUND TUNNEL INVERT

CALIBRATION TESTS NEEDED TO INTERPRET RESULTS

The interpretation of the photoelastic pattern around the tunnel requires a calibration test to determine the intensity of shear represented by each fringe. Following the method used in the 1937 tests, this was performed by applying a strip load and computing the shear at a point on a fringe of some specific order. In the dam tests it was felt necessary to cast a separate slab of gelatin for this purpose. In the present investigation it was easier and better to perform the test on the horizontal boundary of the same gelatin sheet that contained the model, since the dimensions were such that no important interference of patterns resulted. At first a beam device was used to load the footing. This necessitated placing the footing near the edge and resulted in an unsymmetrical pattern. Later a single sliding rod topped with a load pan was used to exert pressure on the footing. It was found that friction in the sleeve could be reduced to a negligible amount.

Since the calibration "pressure bulb" was far outside of the illuminated field, a separate light source and camera were required to obtain readings simultaneously with the other test. A microscope illuminator was finally adopted for a light source, providing a $2^1/_2$-in. field; and polaroid disks, a filter, and a candid camera completed the calibration apparatus. Figures 3 and 4 show one of the calibration patterns and the computations of F based thereon.

Actual results of the tunnel tests cannot be presented as yet, but the typical shear distribution pattern shown in Fig. 5 illustrates the nature of the data obtained.

In conclusion it should be noted that construction of the apparatus described here was made possible by labor furnished through the Works Progress Administration.

In Search of the North Boundary of Wyoming

A Study of the Field Notes of the Original Survey and an Account of Recent Retracements

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WHERE is the north boundary of Wyoming? Oddly enough, no complete answer can be given to this apparently simple question. The line was originally run in 1879–1880 and parts of it have recently been retraced, as described by Mr. Bandy. But its true position from the 63-mile to the 90-mile corner, and in long stretches of the Big Horn Mountains, is still unknown. This does not seem so strange after one has read Mr. Bandy's descriptions of the country and the difficulties it presented to the original surveyors—and still presents to those who attempt to follow in their footsteps.

THE boundary line between the states of Montana and Wyoming, designated in the field notes of the original survey as the "North Boundary of Wyoming Territory" was surveyed in 1879 and 1880 under instructions issued by the Commissioner of the General Land Office. The instructions provided for the initiation of the survey at the northwest corner of Wyoming Territory, which had been established by a previous survey in 1873. The line was to be produced east along the 45th parallel of latitude, with corners established every mile.

The survey party was outfitted at Green River City, Wyo., in July 1879, and traveled overland by horseback and pack train for several hundred miles to the initial point of the survey. The party consisted of Rollin J. Reeves, astronomer and surveyor, who was in charge of the survey; H. P. Tuttle, astronomer; and an average of about 16 assistants, including packers, chainmen, axmen, and other helpers. They had about 50 head of "horses, mules, and jackasses," according to the field notes. They left Green River City on July 28, 1879, and traveled up Green River to Big Sandy Creek, thence up Big Sandy and Little Sandy creeks, through South Pass to Lander, and on to Fort Washakie, Wyo. There they were joined by a company of soldiers from Fort Washakie, who acted as a military escort to protect them from the Indians. Thence they moved up Wind River to its head, where they crossed a divide and followed up Pacific Creek, crossing the continental divide through Two Ocean Pass. From there they went down the headwaters of Yellowstone River to the south end of Yellowstone Lake, passing around the lake on the west side. The difficulties encountered through these rough mountains are best described by quoting from the field notes of the original survey party:

"The route was through dense timber all the way. The grades were frequently very stony, steep, and prolonged. The trail frequently could not be found at all, and we had no guide with us. In many places the down timber and undergrowth were matted so closely and firmly we could not get through it. Swamps were numerous, and the ground was miry and deceptive. Altogether it was unqualifiedly the most laborious, long march I have ever made. We were lost for several days at a time. Notwithstanding these trials we enjoyed many features of the journey. No sickness, loss, or accidents were suffered, and no fights fought, though bickering, backbiting, and grumbling were indulged in as they always will be on expeditions of this kind."

They crossed Yellowstone National Park to Mammoth Hot Springs, where they replenished their food supply by sending parties to Bozeman and Fort Ellis. They then went westward across the Park to the initial point of the survey, which was reached on September 2, over a month after they left Green River City.

In projecting the line eastward the tangent method of determining the true latitude curve was employed. That is, the true meridian was established at the point of beginning; a deflection angle of 90° was turned to the east; and a straight line, called the tangent, was carried eastward until a suitable place for another astronomical station was reached, but never to exceed 27 miles. As the measurements were completed for each corner point, proper offsets were made north from the tangent to the parallel, upon which line the corners were established. In projecting this line across the rougher areas, the general practice was to flag the line from ridge to ridge, and then triangulate across the canyons. Afterwards they would measure out from the triangulation stations and establish such intermediate mile corners as were found to be accessible.

ORIGINAL SURVEY WELL DONE CONSIDERING HANDICAPS

Although errors in alinement and measurement have been found, the survey as a whole was well executed, taking into consideration the adverse conditions under which it was made. This is especially true of the construction of the corner monuments. In almost every instance these have been found to have been constructed in strict conformity with the instructions. Unfortunately, the instructions specified the use of wood for corner posts, instead of a more durable material. The result is that after a lapse of nearly 60 years many of them have fallen down and are badly decomposed, while others are not in their true positions. The true position for most of them can still be recovered by reference to the remaining traces of the original pits, bearing trees, or other accessories; however, it is only a matter of time until some of these corners will be entirely lost.

The Author's Pack Train Along the Summit of the Absaroka Range, East Boundary of Yellowstone Park

A careful study of the field notes of the original survey, although they are brief and generally confined to comments pertinent to the actual survey procedure, reveals some of the hardships suffered by the party and the difficulties encountered. These would appear to justify the omission of some of the refinements we might think should have been employed for a survey as important as this.

The following quotations are taken from the field notes of the line in the vicinity of Electric Peak in Yellowstone National Park:

"In crossing this barrier our hardships were peculiarly severe. On the evening of September 6th after quitting work on line our party started down the mountain to find camp. We divided into five smaller companies. The camp was not found until noon of the next day, all hands having lain out, without shelter or food since the morning of the 5th. I walked fully twenty miles trying to find the pack train and I think others traveled as far."

PART OF AUTHOR'S SURVEY PARTY ON LINE IN THE ABSAROKA RANGE

They quit work at the close of the season of 1879 a few miles east of Cooke City, Mont. Of the last few days of the season the surveyor has this to say:

"On the morning of October 6th a light snow was falling . . . . On the morning of the 9th while it was still snowing, a part of our number went out on line and brought in the instruments and tools that had been left on line the evening of the 5th. Although this point was not two miles from camp, it was about the hardest day's work experienced by several members of the party during the survey. The surface is covered with fallen timber, dense undergrowth, and vast quantities of boulders and broken stones. The snow was wet and heavy. As it fell from the trees and willows it drenched the men through and through. It required nearly all day to bring in the instruments. Accordingly the camp was disbanded, some going to Yellowstone Park, some to Bozeman, some to Crow Agency, and others to Fort Washakie."

"Our party was constantly supplied with fish and fresh meat. Elk, deer, and antelope were as numerous as dogs in an Indian camp. As to buffalo, we saw hundreds and killed several, seven in one afternoon."

The last corner established in the fall of 1879 was set at 60 miles plus 31.12 chains and was designated as the witness corner to the 60-mile corner. This is the first corner established east of the high divide extending north from Index and Pilot peaks, two prominent landmarks. The distance to this corner was determined by a complicated triangulation, in which an error was made, causing the calculated distance to be 49.10 chains less than the actual distance. This error, discovered when the retracement was made in 1936, caused the retracement party to lose considerable time in searching for the witness corner. In fact, the original survey party had had a great deal of trouble in finding this corner themselves when they returned to resume the survey in August 1880. After searching several days for the starting point without success, they made astronomical observations to determine the latitude to aid them in the search. These observations were made at what afterwards proved to be a point near the 63-mile corner, whence they ran west and found the corner they were looking for. The terrain here is rather flat and is covered with heavy timber and dense undergrowth, with vast quantities of large rocks.

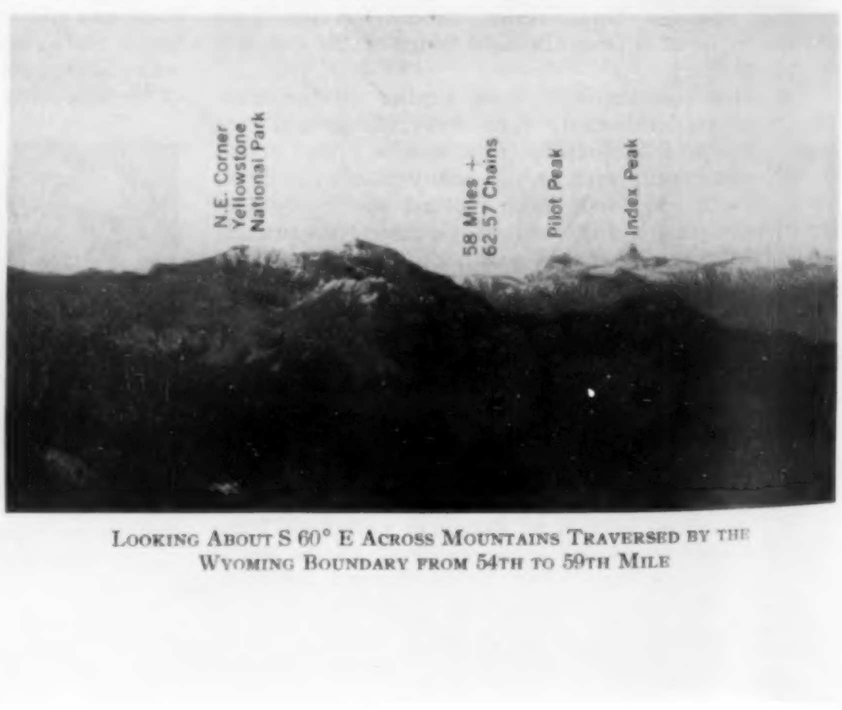
It was about ten miles east of here that the original survey party lost one of their men in the summer of 1880. This man's name was Hopkins and he was listed as a cook. He probably was lost while they were on the move. This incident is described in the field notes as follows:

"From the 73rd mile eastward the entire region is almost impassable. We lost one man (Mr. Hopkins) in the 75th milem and it is supposed he must have fallen down one of the numerous horrible canyons which are notorious in that region. His horse and coat were found, but not himself, though vigorous search was made for him along the streams and lower elevations."

On account of the rough, impassable nature of this part of the line, no corners were established for eight miles, from the 73rd to the 81st mile corners, and also for three miles from the 85th to the 88th mile corners.

The line leaves the mountains on the 91st mile and follows across a flat grassy bench to the Clarks Fork River, where another astronomical station was established.

Nothing of particular interest is found in the record of the trip eastward from Clarks Fork River until the Big Horn River was reached. Here the party waited two or three days while log rafts were constructed to make the



LOOKING ABOUT S 60° E ACROSS MOUNTAINS TRAVERSED BY THE WYOMING BOUNDARY FROM 54TH TO 59TH MILE

crossing. Eastward from the Big Horn River the next real barrier they encountered was Devil's Canyon, an impassable gorge leading into the Big Horn River from the east, out of the Big Horn Mountains. They arrived at the west side of this canyon on the 145th mile, and describe it as being one-quarter of a mile wide at right angles to its course, but about a mile across on line. Their trip around the head of the canyon is described in the field notes as follows:

"All hands left the line taking their tools with them and started in a southeast direction to follow the pack train which had gone on ahead to cross the canyon at the nearest passing point. We followed up the southwest side of this great canyon all day and went into camp just before dark 20 miles above where we had left off work. Have been climbing the Big Horn Mountains all day and have ascended about 2,000 ft above the witness corner. This is on Friday night August 27. Saturday August 28th, marched all day and about 3 p.m. found a crossing at head of canyon, returning down the other side of the canyon, camping that night at an elevation of about 10,000 ft about 5 miles south and 7 miles east of the objective point on the west edge of Big Horn Mountains. Have traveled about 18 miles.

"August 30, 1880: It rained and snowed all day today, and we spent a miserable day in camp.

"August 31, 1880: It being impossible to take the pack animals farther west on the line on account of the steep rocky character of the western slopes of the mountains; the party with the necessary tools are now taken down the mountains to a point on the east side of the canyon opposite the 145-mile corner. The distance across the canyon is measured by triangulation, and the party go into camp without blankets and without supper."

The Author's Survey Camp at Timber Line in the Absaroka Range—El. 9,300 Ft

They report that the line from the 145-mile corner to the astronomical station established on a white cliff on the east side of the canyon, crossed a bend in the impassable canyon that could not be crossed, so they triangulated all the way to the white cliff, a distance of 11 miles and 8.01 chains; thus no corners were established along this portion of the line for a distance of 11 miles.

When they reached the valley of the Little Big Horn River, they found several settlers waiting to see where the state line would fall so that they could "squatt" on the land on the Wyoming side, which would be off the Crow Indian Reservation and open to settlement by whites. Mr Reeves described this valley as the best agricultural land he had seen in Wyoming Territory.

As they crossed the plains eastward from the Big Horn Mountains they reported seeing many herds of buffalo, which are described as "gentle, grazing and sleeping all around us while we worked." Near the 332nd mile they reported: "Great herds of antelope were seen which were being killed for their skins." On October 21 a prairie fire burned their camp and they reported a loss "of 25 saddles, blankets and riggings, all clothing, 500 rations, much bedding and some tools. I lost between $400 and $500 worth of equipment in this fire."

The survey was completed on October 23, 1880, at the intersection of the line with the west boundary of South Dakota. In summing up his experiences Mr. Reeves mentions the difficulties in keeping the survey crew recruited to full strength:

Pack Mules Being Transported to the End of the Road, Where They Will Have to Take Over

"Wages of $50 to $100 per month and board were paid. Any man had a right to demand his pay in cash at any time. I carried constantly on my person from $900 to $1,700 in currency and every man was paid in cash on demand. These mountaineers are a very independent class and you cannot enlist them for a longer time than they want to stay."

For future work he recommends the use of enlisted men of the Army for field assistants.

Retracing Reveals Numerous Jogs in Boundary Line

Retracements of portions of this boundary have been made in recent years by the Surveying Service of the U.S. General Land Office in connection with the cadastral survey of the land adjoining it. These retracements reveal that, instead of the boundary being a straight east-and-west line as described in the field notes, there are jogs to the north or south at several points of as much as nearly a half mile.

These offsets are due to the fact that when, in the course of the original survey, astronomical observations for latitude and longitude indicated that the line was not on the true 45th parallel of latitude, the surveyors set over the necessary amount. They seem to have made no effort to correct the line back of these astronomical stations, and no mention is made of the offsets in the official field notes.

In retracing the line, many of the corner monuments were very hard to find, particularly in the rough timbered country east of Yellowstone National Park. Occasionally we were able to find blazed lines that appeared to have been made at about the time of the orginal survey, judging from the growth of the trees, but the corners were never on the blazed lines. The field notes state that the line was projected as a "tangent" line, with proper offsets to the north to place the corners on the true parallel of latitude, and that the tangent was blazed. However, the corners were found south of the blazed line as often as north of it, the variations being sometimes as much as four or five chains to the right or left. These irregularities made it necessary for us to cover a lot of ground in searching for the old corners, and the work was not easy in this mountainous country, covered with heavy timber, fallen logs, and dense undergrowth.

Error Found in Original Survey

It was in this country that we found an error of 49.10 chains in measurement, the 60th mile being that much too long. We spent a part of four days searching for this corner, which is designated as the witness corner to the

60-mile corner. This witness corner is in the lower part of the mountains about 6 miles east of Cooke City, and is the first corner established east of the high dividing ridge that extends northward from Index and Pilot peaks. The elevation of the ridge where the line crosses it is 10,362 ft above sea level.

As the original surveyor approached this high divide he read a bearing to the top of Index Peak, about $1^1/_2$ miles south of the line. Then after setting a flag on line on the divide he proceeded to it and determined the bearing from there to Index Peak. Knowing the distance along the line to his flag on the divide, he was able to calculate the distance to Index Peak, which he found to be 120.77 chains. He then went down into the lower country east of this divide and picked up the line by sighting back at his flag. To determine the distance to this point he says he determined the bearing to Index Peak and calculated the distance. However, he must have either sighted at the wrong peak or misread the bearing, for there is an error of 49.10 chains in this triangulation, although his distance from the line to the top of Index Peak is approximately correct.

ABOVE: REMAINS OF ORIGINAL BEARING TREE OF 63-MILE CORNER. BELOW: REMAINS OF 97-MILE CORNER

We did not know of this error, of course, when we started to look for the witness corner; therefore we spent considerable time searching for it over a half mile from where it was afterwards found. The terrain here is very broken, cliffy, and covered with heavy timber and fallen logs. There are also numerous small lakes and marshy places surrounded by dense undergrowth and infested with mosquitoes. We found an occasional blaze but it only led us farther astray. Finally we decided to continue the search eastward three miles to the 63-mile corner, which we were able to find, after an extended search, because of a reference in the original field notes to a grassy park to the south of it, and a dome-like mountain to the north. The wooden post was lying on the ground and was charred black on top. There was no mound of stone, and the bearing trees were all dead and fallen. The man who found it had his attention attracted to it by its regular shape, as it was about the right length and seemed to have been squared off across the ends. When he picked it up he noticed some scribe marks on the sides. Its true position was then determined from the stumps of the old bearing trees. (See accompanying photograph of one, showing how new growth extended partly over old marks before tree was killed and mostly rotted away, leaving shell of stump.) Then, by running the line back west we were able to find all the intervening corners, including the witness corner previously referred to. This witness corner was found to be marked by chisel marks on the flat surface of a granite outcropping about 60 ft long by 20 ft wide. The marks could barely be distinguished even when we were reasonably sure we had found the corner point—and then only after we had wet the surface with water from our canteens.

The next section of line retraced was from the 90- to the 98-mile corner. The line leaves the Beartooth Mountains on the 91st mile and from there eastward crosses a flat grassy bench, with scattering sagebrush. The corners on this bench were constructed of wooden posts, with pits dug in the soil for accessories. These monuments were almost completely obliterated and were very difficult to find.

The 97-mile corner is on the edge of this bench overlooking Clarks Fork Valley, and one of the jogs in the line occurs in the 98th mile. From the 97-mile corner the true bearing of the state line is S 66° 17′ E, for a distance of 86.00 chains to the 98-mile corner, which is on the west bank of Clarks Fork River. The observation for latitude made at the 98-mile corner indicated to the surveyors that they were not on the true 45th parallel of latitude; consequently they set over nearly a half mile to the south and started their line over again. However there is nothing in the field notes to indicate such a bearing as this in the line.

An idea of how the corner monuments on this bench have deteriorated can be gained from the fact that all we were able to find at the 97-mile corner was a chip of cottonwood about 4 in. long lying on the ground. Since there were no trees or fences within a mile or more, we were quite sure that this chip was a part of the original corner post. (As shown in the accompanying photograph, we could make out the marks "NL 1800," signifying 45° north latitude, set in 1800. The "45°" had weathered away). We then discovered traces of the old pits by observing that the fine surface gravel was thicker in two slight depressions. After skimming off the surface of the ground we were able to definitely identify the old pits by the difference in texture and color of the soil.

In accordance with the usual practice of the General Land Office, partially obliterated corners were reconstructed by planting iron corner posts 3 ft long by 3 in. in diameter, with brass caps on which are stamped appropriate marks.

TRUE POSITION OF STATE BOUNDARY STILL UNKNOWN

The true position of the state boundary of Wyoming from the 63-mile corner to the 90-mile corner is still unknown. This part of the line has not been retraced. It passes through a very rough and mountainous country that is entirely uninhabited, and it is probable that no one has seen many of the corners since they were established sixty years ago. This area is traversed by the famous Cooke City Highway, and is being developed into quite a recreational region. However, because this line has not been retraced and the corners found, National Forest officials, game wardens, and others interested in administering the laws in this area do not know in which state certain camps, fishing streams, and lakes are located. In fact, latitude determinations made to the west and east of this part of the line indicate that there is a latitudinal difference of close to a half mile between the 63- and the 90-mile corners. Therefore it is probable that there is at least one jog of close to a half mile somewhere along this part of the line.

There is another known jog of nearly a half mile in the boundary where it crosses Powder River. This is at another astronomical station. Long stretches of the boundary through the Big Horn Mountains have not been retraced, and it is not known just what the condition of the line in that section is.

The retracements here described were made by the Cadastral Engineering Service of the General Land Office, under the authority of Fred W. Johnson, commissioner of the U.S. General Land Office. Frank M. Johnson, M. Am. Soc. C.E., is supervisor of surveys; John P. Walker is district cadastral engineer for District 7 (Montana); and Herman Jaeckel is district cadastral engineer for District 5 (Wyoming).

Operations and Plans of the Port of New York Authority

Second of a Series on the Port of New York

By Glenn S. Reeves

Member American Society of Civil Engineers

Engineer, Port Development, The Port of New York Authority, New York, N.Y.

Union Inland Freight Station No. 1, Built by the Port Authority, Saves Shippers Large Sums by Reducing Handling and Trucking Costs of Less-Than-Carload Merchandise Freight

This is the second of a series of articles on the organization of the Port of New York, originally presented as a symposium before the Waterways Division at the 1940 Annual Meeting. In it Mr. Reeves discusses the three major functions of the Port of New York Authority—planning and negotiation (which he calls the "statecraft of engineering"); design and construction; and protection of the interests of the port in any proceeding affecting its commerce. Other papers from the symposium will appear in forthcoming issues.

In the March 1940 issue of Civil Engineering, Colonel Hall has given a clear description of the geography of the Port of New York, its unique problems and growth, and the complex administrative situation involved. This broad background is indispensable to a proper perspective and an intelligent consideration of the Port of New York Authority, its functions and operations in the Port of New York.

The ramifications of the Port Authority's work are many and varied. In the field of channel improvement, it is necessary to cooperate with the War Department. In dealing with ice conditions in the harbor and enforcement of anchorage rules, the Authority cooperates primarily with the U.S. Coast Guard and the U.S. Navy. In the use of piers and pier slips, and the regulation of such use, the Authority confers with officials of the City of New York, which owns and controls a large number of the Manhattan piers. In reference to navigation laws and rules, it cooperates with the Treasury Department through the Collector of Customs, who also acts under the Secretary of Commerce. In the matter of marine transportation hazards, it is necessary to cooperate with the Bureau of Navigation and Steamboat Inspection of the Department of Commerce. In considering the consolidation of belt lines, the transportation of explosives by rail or truck, and various other matters, the Authority cooperates with the Interstate Commerce Commission. These are a few of the many items that call for contact and mutual study with other agencies.

From the first, the Port Authority has seen the problems of the port from the viewpoint of the civil engineer. The conception of a bi-state agency dedicated to the development of this region as a unit had its origin in an engineering study—the report of the New York–New Jersey Port and Harbor Development Commission, published in 1920. The Comprehensive Plan of port development adopted by New York and New Jersey in 1922, and consented to by Congress, is an engineering plan for the improvement of our transportation facilities. Broadly speaking, all our past achievements and future plans are within the sphere of civil engineering, although many of them range far beyond the conventional conception of the engineer's job.

The Port Authority's work may be roughly divided into two parallel and interrelated fields. There is, first, the task of study and planning, of survey and negotiation—what might be called the statecraft of engineering. In this function the engineer works hand in hand with the lawyer, the statistician, the economist, and the financier. Second is the vast province of design and construction, in which the engineer translates plans into reality. I might add a third field of activity—port development and the protection of the commerce of the port before the various regulatory commissions, agencies, and congressional committees, whether such commerce moves by rail, highway, or water.

It is not until our work reaches the second phase that the public becomes really aware of it. The George Washington Bridge, for example, is a monumental structure in which the community takes pride. Yet quite as important as the tangible structure itself is the solid economic foundation on which it is based. Careful analysis of highway traffic data, motor-vehicle population, travel habits of the motoring public, minute and exhaustive examinations of sites, and connecting approach routes and estimates of costs—all these preceded the final decision to build the George Washington Bridge. The Port Authority operates on the two-fold responsibility that its projects must not alone serve the community but must sustain themselves without tapping the tax funds of either state.

Another impressive engineering accomplishment is Union Inland Freight Station No. 1, which is saving shippers large sums by reducing the handling and trucking costs of less-than-carload merchandise freight. This terminal is located in the Port Authority Commerce Building at 111 Eighth Avenue, New York City. The history of the development leading up to this project gives an idea of what I mean by the statecraft of engineering. The original bi-state plan, adopted by New York and New Jersey, outlined nine major engineering principles to guide the Port Authority. One of them was that freight should be brought to all parts of the district. The Port Authority was further instructed to devise "definite methods for prompt relief." In this situation, the major problem was to convince the eight trunk-line carriers, not only that the plan was sound from a broad economic and engineering viewpoint, but also that it represented sufficient savings to them to warrant abandoning competitive individual facilities. Detailed studies of costs, volume, and kind of traffic handled annually by each railroad were made. In 1924 alone, the freight operations of 15,000 business concerns were analyzed—all for the purpose of furnishing the needed economic proof. It was not until 1929—after inland stations had been inaugurated by several individual railroads, after a plan for store-door delivery had been placed in operation, after eight years of study, discussion, and negotiation—that the Railroad Presidents' Conference Committee agreed to use one union inland terminal for less-than-carload, non-perishable merchandise freight. The Port Authority thereupon undertook to build this first facility and has agreed to construct two more when and if requested to do so by the railroads.

We are now engaged in further study of the Port District's freight problem, with particular reference to the tremendous shift in tonnage from rail to truck. Indications are that our next project may be the construction of one or more union terminals for motor trucks—a task we know in advance will demand the same careful study and impartial analysis (and, I might add, endurance) that any comprehensive improvement requires.

One other major project—also a part of the Comprehensive Plan—under study is a railroad freight tunnel under New York Bay connecting the railroads at Greenville, N.J., with the Long Island and New York Connecting Railroads at Bay Ridge, Brooklyn, N.Y. At present, freight in railroad cars for Brooklyn, Long Island, and New England moves between the two sides of the port on car floats each with a capacity not exceeding 23 cars. There is no direct rail line for moving full freight trains across this harbor. Such a rail link as would be afforded by the Greenville–Bay Ridge Freight Tunnel would expedite the handling of freight through the port and be of inestimable value in the event of a national emergency. Up to now no satisfactory method has been found to successfully finance this cross-bay project.

One of our major assignments is the operation of six interstate vehicular crossings, which in 1939 handled a total traffic of 25,741,000 vehicles. Large-scale problems of safety and traffic engineering, of policing, of collecting and recording tolls, as well as of maintenance work on tunnel and bridge facilities are involved. The Port Authority is, I believe, today the largest operator of vehicular bridges and tunnels in the world. Because of the changing transportation methods, notably the shift in freight tonnage and passenger movements from rail to rubber, these facilities have come to play a major role in the metropolitan district's transportation picture. A total of 3,671,000 motor trucks and 1,492,000 buses used our interstate crossings in 1939.

In so far as our future bridge and tunnel program is concerned, the only unfinished business on our present agenda is the interior finish and ventilation, lights, and pumps, for the second tube of the Lincoln Tunnel, which will be completed as soon as justified by the traffic volume. I might add here that traffic through the Lincoln Tunnel, which at the outset was and to a large extent still is retarded by the factor of inadequate New Jersey connecting highways, is rapidly increasing, the present daily average being 10,000 vehicles.

Also on our current program is the problem of recommending to the New Jersey Legislature a plan complete in all its engineering, financial, and legal details for providing better suburban transit facilities, more commonly referred to as commuter facilities, for northern New Jersey. Although the suburban passenger problem was not specifically assigned to us in our original mandate from the states, it was at an early date referred to the Port Authority by the State of New Jersey for study and solution. In so far as the technical engineering phases are concerned, we believe we have a physical solution on paper. It makes maximum use of existing facilities, rail and bus, and adds a short new rail and subway line under the Hudson River into Manhattan with distribution through the midtown area from Radio City to 8th Street. What remains is a problem of political and financial engineering. Our studies show that, on the basis of conservatively estimated traffic and revenues, the proposed system cannot be self-sustaining with fares at their present levels. Some form of subsidy will be needed. This has led us into questions of state legislative policy, which we are now exploring with a special subcommittee of the New Jersey State Legislature.

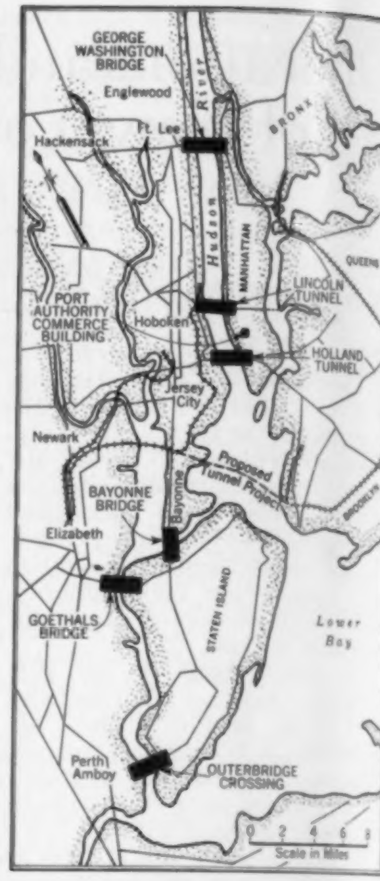


FIG. 1. LOCATION OF PORT AUTHORITY FACILITIES AND PROPOSED CROSS-BAY UNION RAILROAD FREIGHT TUNNEL AND CONNECTIONS

As Colonel Hall has said, the creation of the Port Authority in 1921 was an event of major importance. We were and are the only body engaged in the development of this port as a complete unit. This brings me to the third major function of the Port Authority. The compact creating the Port Authority instructed us to intervene before any tribunal in any proceeding affecting the commerce of the port. The communities of the district have come to look upon us to take the lead in countless situations—whether it be one affecting the depths or clearances of channels leading to their docks, or one affecting the rates and differentials on commerce moving into or through the port. We have been called upon to protect the interests of the Port of New York continuously for the past 18 years in formal proceedings or informal negotiations with such bodies as the Interstate Commerce Commission, the Maritime Commission, the Corps of Engineers of the Army, the regulatory bodies of each state, and various committees of Congress. Rate questions both domestic, import and export, port differentials, lighterage issues, problems of terminal charges, safety regulations, and numerous other related issues, have been involved. Through these years we have built up a small staff of experts especially qualified to deal with the complicated phases of these problems.

Proper development of the port involves many problems, not the least of which are the river and harbor channels. The Port Authority has been active in a co-

IN THE ABSENCE OF A TRANS-HARBOR RAIL LINE, CAR FLOATS MAKE UP A LARGE PART OF THE WATER-BORNE RAIL TRAFFIC MOVING ACROSS THE HARBOR

operative and advisory capacity in furthering in this district the waterway improvement projects described by Colonel Hall. One of the clauses of the bi-state plan instructed the Port Authority that "there should be urged upon the federal authorities improvement of channels so as to give access for that type of water-borne commerce adapted to the various forms of development which the respective shorefronts and adjacent lands of the port would best lend themselves to."

The ultimate decision in determining whether a waterway channel should be improved or modified, or whether the clearances for a bridge or tunnel are adequate for the commerce using the waterway, lies with the Secretary of War. However, the various secretaries of war have known that the two states and congress directed the Port Authority to advise and recommend in this field. Both the Secretary of War and his local representatives have requested our recommendations on such projects. The Port Authority has made it a practice to appear at public hearings involving such matters as channel improvements, harbor lines, bridge and tunnel clearances, to give the District Engineer or the Board of Engineers for Rivers and Harbors sitting in Washington, and in some cases committees of Congress, its views regarding the effect of such proposals on commerce and navigation in the port. These projects range from shallow channels over which move barges of fuel and building materials in the secondary waterways of the port, to the 48-ft channel project in the Hudson River leading to the transatlantic passenger piers at 50th Street.

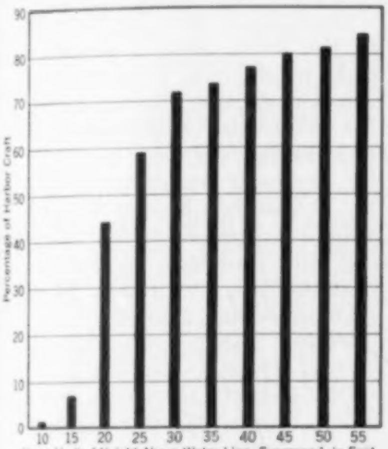


Fig. 2. Limiting Height of Harbor Craft (All Types) in the Port of New York

Showing That 35-Ft Bridge Clearances Would Solve 75% of the "Grade Crossing" Problems Between Highway and Marine Traffic

Bridges over port waterways can be one of the greatest hindrances to navigation. A leading example of Port Authority participation in protecting navigation interests from an undue hindrance was its opposition to the proposed North River bridge over the Hudson at 57th Street, the building of which would have crippled the city's investment in the new transatlantic piers. This argument extended over several years—first before the District Engineer and later to hearings before congressional committees and the Secretary of War on the question of congressional action on an extension of the date when the bridge company should have started construction. This franchise expired September 22, 1937.

Another instance was that of the Marine Parkway Bridge over the entrance to Jamaica Bay, where the City of New York and the federal government had jointly spent over $18,500,000 in channel and marine terminal construction for a 30-ft channel to the terminal at Canarsie. The Marine Parkway Bridge from the end of Flatbush Avenue in Brooklyn to Rockaway Beach, as originally planned, would have provided an opening width of only 300 ft at a point where the government channel is 1,500 ft wide, and would have frustrated for all time the possibility of developing Jamaica Bay as an auxiliary commercial port. Out of this opposition grew discussions around the conference table between the District Engineer, the Port Authority, and the Marine Parkway Authority (which was proposing the bridge), resulting in a revision of plans so as to provide three 500-ft openings available to navigation.

While all the recommendations made to the Army Engineers by the Port Authority staff are advisory in character, they are based upon careful economic surveys of the present commerce and needs of navigation, giving due consideration to the needs of land commerce and traffic where it may be in conflict with that moving on the waterway.

In general, we have recommended a standard depth of 12 ft for secondary channels, which is ample for the movement of 1,000-ton barges with the tide, and minimum bridge under-clearances of 35 ft, as the solution of 75% of the "grade-crossing" problems between highway and harbor marine traffic. In an effort to know more exactly the clearance requirements, and as an aid in the solution of this problem, we have just completed, in cooperation with all the harbor and marine agencies at the port, assisted by the Works Progress Administration, a survey of harbor craft using the secondary channels in the port, covering the hull dimensions and maximum height of more than 3,000 tugs, barges, and miscellaneous craft. The tabulation and analysis of this material are now being completed and will shortly be transmitted to the District Engineer.

The main interest and concern of the Port Authority is transportation, and most of its efforts have been aimed in that direction. Contrary to certain public conceptions, the Authority does not own, nor does it control, any railroads, boats, piers, or other such property that might be included under the general term harbor appurtenances.

In all the surveys and plans for the better functioning of the port, no one has ever seriously advocated that these various items be placed under the ownership or control of the Port Authority or of any other single agency. The geography of the port, and fundamental laws both state and national, as well as custom and precedent, would make such an autonomy well-nigh impossible. Nor is such absolute ownership, control, or direction by a single agency deemed necessary. The corporate powers of the Port Authority are such that it could do many things—it could own and operate terminal railroad lines; it could own and operate piers. But the states, in creating the Port Authority, did not direct that it do these things. The Authority was created for the purpose of carrying out a continuing policy of cooperation between the two states, directed toward the development of the port.

Approach from the New Jersey Side of the George Washington Bridge — only Interstate Bridge Crossing the Hudson River

Northern Rail Lines Across the Divide

Last of Three Articles on Railway Routes Across the Rocky Mountains

By Ralph Budd

Member American Society of Civil Engineers
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In this paper Mr. Budd tells the story of Marias Pass which John F. Stevens found, just in time, for James J. Hill, who was about to build the Great Northern on a circuitous route far to the south. He also describes the Canadian Pacific line through Kicking Horse Pass, and the Canadian National through Yellowhead. He concludes that an engineer today, with all present knowledge at his disposal, could not greatly improve on the several major crossings of the continental divide now in use. This article, together with those in the February and March issues, constituted the annual dinner address for 1938 of the American Branch of the Newcomen Society.

The Pacific Railroad Surveys made by U.S. Army Engineers, and the crossing of the Rockies in nine places by six railroads, have been described in my previous papers. It remains only to discuss one crossing in the United States—that of the Great Northern Railway along the southern boundary of Glacier National Park—and the three in Canada.

GREAT NORTHERN

Between Mullan Pass (near the present city of Helena) and the Canadian boundary, a distance of 200 miles, the Pacific Railroad Surveys reported no pass suitable for a railway, although Isaac I. Stevens, who headed the northern party, always thought there was one at the headwaters of the Marias River that had eluded him.

There was documentary evidence that such a pass existed. Robert Greenhow, Librarian to the Department of State, wrote a pamphlet in 1840 entitled *Memoir, Historical and Political, on the Northwest Coast of North America and the Adjacent Territories*, which was a statement of the United States' claims to Oregon, and no doubt was influential in settling the boundary question. Our interest in this pamphlet, however, is not in its text, but in the map that accompanied it, which shows very clearly a trail marked "Route Across the Mts." exactly where the Great Northern main line is now located through Marias Pass. Diligent search in the archives of the State Department and Library of Congress has failed to reveal the sources of information used in making this map, so it only adds to the mystery of the pass. Governor Stevens mentions Marias Pass more than fifty times in his reports, and after his request to extend the explorations into another year was peremptorily refused by Secretary of War Davis, he wrote a final letter on April 20, 1855, to the Secretary calling attention to evidence that such a pass was seen by James Doty of his party, but not explored. He closes this letter as follows: "There is every probability of the existence of a wide, open pass, formerly in extensive use by the Indians, some 20 miles south of the pass explored in 1853 by A. W. Tinkham, Asst. Engineer."

John F. Stevens at the Time of Dedication of the Statue Erected in Honor of His Discovery of Marias Pass

He was right, but no systematic search was made for it until James J. Hill was building the Great Northern Railway through to the Pacific in the late 1880's. Mr. Hill's line across eastern Montana lay only sixty miles from Canada, but Helena and Butte were so important that he decided to build from Havre 300 miles southwesterly to those cities, which he did in 1887. At the same time a survey was made for a line to the west, through Dearborn Pass, northwest of Helena. But before doing any construction work he investigated every mile of the mountain range northward to the boundary, hoping to find a crossing more directly on his through route. Anxious to push westward with the building, he carried exploration into the winter months, and finally, on December 11, 1889, his reconnaissance engineer found the elusive Marias Pass precisely where Chief Little Dog, 36 years earlier, had told Isaac I. Stevens it would be found. That discovery changed the Great Northern Railway from a circuitous, into a very direct, transcontinental line, with most favorable grades and alinement on both easterly and westerly approaches.

The Great Northern as built follows up the Missouri and Milk rivers, thence in Marias River drainage, on a 1.0% grade, crossing the divide at Marias Pass, without a tunnel, at El. 5,213 ft; thence 14 miles down the west slope on a grade of 1.8% in a defile recently given the official name of John F. Stevens Canyon; and along the Flathead, Kootenai, and Pend Oreille rivers on 0.7 and 0.8% grades.

In honor of the discovery of Marias Pass, the Great Northern erected a heroic bronze statue of the reconnaissance engineer at the pass. It represents him as he was when he made the discovery in 1889, garbed for mountain work in winter, and it stands as a monument not only to him but to all reconnaissance engineers. This hero of Marias Pass is John Frank Stevens, Honorary Member and Past-President of the Society, noted engineer of early Panama Canal days, and later of the Inter-Allied occupancy in Siberia. I believe he is the only living member of the Society to have a major

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Scene on the Mount Robson Section of the Canadian National Railway, British Columbia

mountain pass named in his honor—Stevens Pass in the Cascade Mountains—but that is another story.

The Great Northern built through Marias Pass in 1891 and reached the Pacific Coast early in 1893. So ended the quest, begun by Meriwether Lewis in 1806, for a pass at the source of the river which he called Maria's "in honor of Miss Maria Wood . . . that lovely fair one."

Canadian Passes Explored

The United States Railroad Explorations may have stimulated the British Government to secure similar information about railway possibilities in Canada. At any rate, such investigations and reports were made under the direction of Captain John Palliser during the years 1857, 1858, 1859. They were published in four folios of official papers, entitled "Explorations in British North America," illustrated by splendid maps, and reflect painstaking field work. Palliser's principal assistants were Dr. James Hector, Lt. Thomas Blakiston, Monsieur E. Bourgeau, botanist, and J. W. Sullivan, secretary to the expedition. The Hudson's Bay Company possessed a vast amount of information about the country which it made available, and also rendered invaluable assistance in many other ways.

Captain Palliser was an Irish sportsman who already knew the western wilderness and its ways. He had spent the year 1848 in the buffalo country, with principal headquarters at Fort Union, at the confluence of the Yellowstone and Missouri rivers, right where the Great Northern now crosses the North Dakota–Montana boundary. His account of this experience was published in 1853 under the title, *Solitary Rambles and Adventures of a Hunter in the Prairies* and is one of the most delightful books dealing with the big-game era in America. He later was awarded the Victoria Gold Medal, elected a Fellow of the Royal Geographical Society, and awarded the Companionship of Saint Michael and Saint George. Palliser's party left many place names in the Canadian Rockies, among them being Kicking Horse River and Pass. The occasion for this name was an accident to Dr. Hector, which occurred when one of his horses objected to the placing of the pack on its back and severely kicked him on that particular morning in 1858.

Canadian Pacific

Three main-line railways cross the Canadian Rockies. The southerly line of the Canadian Pacific, completed in 1898, occupies Crowsnest Pass at altitude 4,459. Owing to its close proximity to the United States boundary, and the rugged country to the west, the traffic on this route is relatively light. From the east, it follows up South Saskatchewan River tributaries on a 2.0% grade, crosses the divide in the open at Crowsnest Pass, and descends the west slope on a 1.4% grade in the drainage of the Kootenai River.

The Canadian Pacific's main transcontinental line, completed in 1886, uses Kicking Horse Pass, altitude 5,338. Its course from the east is up the South Saskatchewan, thence along Bow River, on a 1.8% grade approaching the divide, which is crossed in the open at Stephen; and down the Kicking Horse River on the west slope on a 2.2% grade. These favorable data give little hint of the rugged character of Canadian Pacific construction. It is in the Selkirks, rather than in the main Rockies, that the greatest engineering feats were performed, although the spiral tunnels which ease the westerly descent from Kicking Horse Pass are spectacular examples of mountain location and construction.

Canadian National

The Canadian National Railways transcontinental line, connected through in 1914, crosses the divide in the

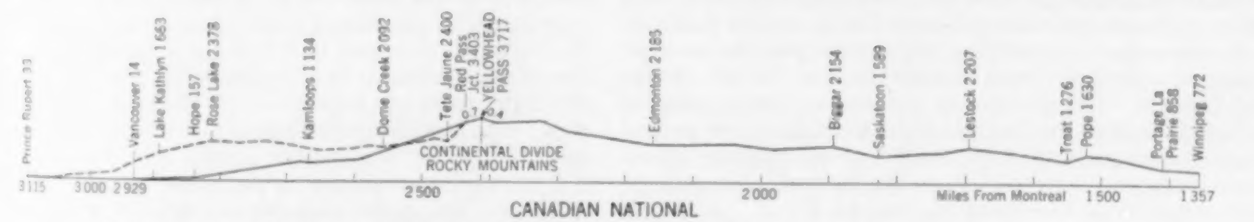

Fig. 1. Profiles of the Three Transcontinental Lines Discussed in This Article

KICKING HORSE TUNNEL AND RIVER ON THE ROUTE OF THE CANADIAN PACIFIC JUST WEST OF THE CONTINENTAL DIVIDE

open at Yellowhead Pass, latitude 53°, altitude 3,717. The eastern approach to the pass is up the Athabasca River drainage on a 0.4% grade except for a short piece of 0.5%, and thence down the west slope on a 0.7% grade in upper Fraser River waters. At Red Pass Junction, 26 miles west of Yellowhead, the line divides. One route goes to Prince Rupert, following first the drainage of the Fraser River, and then the Nechako, Bulkley, and Skeena rivers to the Pacific. The more important route, that to Vancouver, turns south about 46 miles beyond Yellowhead Pass, and after following Canoe River a short distance, descends along the North Thompson to Kamloops, thence along the Thompson River southwesterly to its junction with the Fraser, and down that mighty stream to tidewater at New Westminster and Vancouver. This is the easiest railway gradient across the continent—there is only one summit and that at 3,717 ft above the sea, with very favorable approaches from both directions.

Yellowhead was well known to the Canadian Pacific engineers and officials, but for national as well as economic reasons, in order to occupy the more central and productive areas, they decided on the Kicking Horse route. Something of their courage may be gaged by the fact that they built through Kicking Horse Canyon without being certain how they would get beyond, and while explorations were still under way in the Selkirks.

We have been considering the building of the western railways and their great benefit to the United States and Canada. The portentous meaning of this movement as it appeared to the Indians is reflected in the reports of Isaac I. Stevens and John Palliser, two representatives of their respective governments who were sincere, honest, and sympathetic friends of the Red Man.

At a meeting between Governor Stevens and a band of Assiniboines, on July 27, 1853, near the center of what is now North Dakota, the Old Chief said: "The Great Father of Life who made us and gave us these lands to live upon, made the buffalo and other game to afford us subsistence; their meat is our only food; with their skins we clothe ourselves and build our houses. They are our only means of life—food, fuel, and clothing. But the buffalo are fast disappearing and before many years will be destroyed. As the white man advances our means of life grow less. We hear that a great road is to be made through our country. We do not know what this is for; we do not understand it, but think it will drive away the buffalo. What are we to do?"

Captain John Palliser reports a similar meeting five years later, south of Lake Winnipeg, when the Cree Chief said: "I want you to declare to us truthfully what the great Queen of your country intends to do to us when she will take the country from the Fur Company's people. . . . We will not sell or part with our lands. Now, what is to become of us? We have no more animals; they are all gone, and only for the little fish we take we would starve."

CONCLUDING REMARKS

In these three articles I have enumerated the 13 transcontinental railroad crossings of that "impassable barrier," the continental divide, at various locations from the Mexican border to Yellowhead Pass in Western Canada, a distance of about 1,500 miles. Many engaging speculations suggest themselves concerning some aspects of these various routes by which main lines of railways cross the Rocky Mountains. One of the singular things is that, using widely separated passes, the distances from Chicago or Toronto, for example, to Pacific Coast points by various lines are so nearly the same. A comparison of train timetables will emphasize this surprising fact. The practical routes of course are governed by important intermediate cities, and in choosing a direct itinerary the mountain pass to be used determines the gateway point, and vice versa. For example, whether a traveler from Chicago to Los Angeles will go through Kansas City or Omaha depends upon where the train he patronizes will cross the mountains. Several hundred miles may separate these crossings but the distance traveled and the time required will be nearly the same. Similarly, the routes through the Twin Cities of St. Paul and Minneapolis, and through Omaha, are practically the same length from Chicago to Portland, Ore., although they may be 500 miles apart where they cross the Rockies. For these reasons if an engineer, in the light of all that is now known about the topography of the West, should decide to lay out the shortest and fastest line possible, it does not seem that he could make much improvement over any one of several direct routes. By ignoring large gateway points a good deal might be done, but in the West we do not have enough population or traffic to justify avoiding our large cities with through travel, as may be done appropriately in the East.

It is notable that in many instances the passes at the continental divide are lower than other points both to the east and to the west. This is usually, but not always, occasioned by crossing a ridge or mountain spur to avoid the distance involved in following a tortuous stream to one of its sources at the divide. The distance of 300 or 400 miles from the high point on the east to that on the west, with the continental divide between, indicates how enormous is the mass of the Rocky Mountain range.

The maximum grades on the western transcontinental rail lines are quite uniform—especially if the profiles over the Cascades and Sierras are included—being generally about 2%. Every transcontinental road has been greatly improved, both as to line and grade. Unquestionably they will be further improved, but it seems doubtful whether the rise and fall or the ruling gradients by which the various lines now cross the Rockies will be substantially changed. It also seems doubtful that any of the Rocky Mountain passes now occupied by transcontinental railways ever will be abandoned, or any not now occupied will ever be used by a railway. The search for railway routes across the Rocky Mountains and the competitive struggle for their control is therefore a closed chapter; it remains to perfect the means and methods of operating railroads through them so that the handicap of mountain barriers, once so formidable, may be gradually minimized.

Testing Visibility of Highway Signs

Optical Meter Permits Quantitative Measurements by Which Various Types of Markers Can Be Compared with Reasonable Accuracy

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THE rapid increase in night accidents on highways has led to an intensive study of factors relating to their cause and means of cure. In recent years there has been a much greater increase in night fatalities than in daylight ones, and poor visibility has proved to be one of the most important single contributing factors. Fixed highway lighting has been one of the methods advanced for providing safe seeing, but it will of course prove economical on only a small percentage of the highways; elsewhere the driver must continue to depend solely on his automobile headlamps.

THE LUCKIESH-MOSS VISIBILITY METER AND, AT RIGHT, THE METER IN OPERATION

One of the factors of safe seeing is the visibility of highway warning signs. Various improvements have been incorporated in these to make them more visible at night. Rating of the effectiveness of various types has thus far been based largely on personal impressions of quality of visibility rather than on a definite measurement, mathematically expressed. It was to develop a method, the results of which could be expressed in numerical terms, that the study described in this article was made. Briefly, the tests consisted of illuminating different signs at set distances with a set of headlamps, and taking quantitative measurements of visibility with a Luckiesh-Moss visibility meter.

DESCRIPTION OF THE VISIBILITY METER

A description of the visibility meter is essential to a full understanding of the results of this study. The instrument consists essentially of two colorless photographic filters with precise circular gradients of density. The filters are mounted in an enclosing frame so that they can be held up to the eyes and rotated simultaneously by a small wheel operated with one finger. The instrument is held to the eyes and the disk slowly turned until the object or detail being observed is just barely visible, or at the "visual threshold."

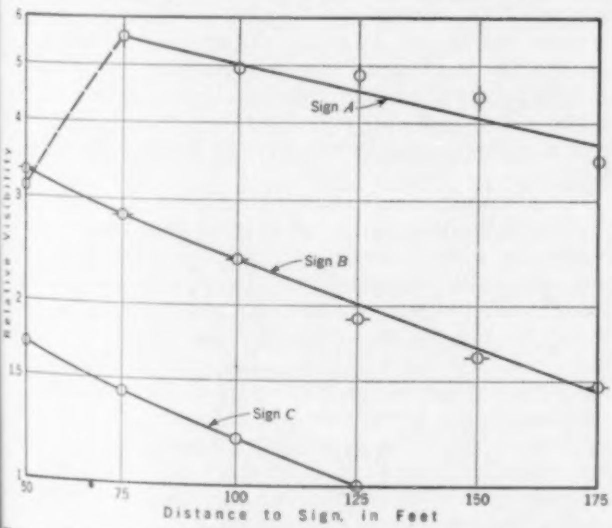


FIG. 1. RESULTS OF TESTS ON RELATIVE VISIBILITY OF THE WORD "STOP" ON THREE TYPES OF SIGN

The Headlights Were on High Beam for the Observations Plotted Here

The meter is equipped with two scales, one of which reads "relative visibility." The range on this scale is from 1 to 20. In the original construction of this instrument a simple calibration procedure was used to establish these points. A standard object under standard lighting conditions was viewed through the instrument and the filters turned until it was just visible; this portion of the gradient filter was assigned a value of "1." A value of "2" would mean that an object was twice as visible, or had twice the area, when observed under like conditions. Other readings have the same relative significance.

For a detailed discussion of the visibility meter the reader is referred to "Visibility: Its Measurement and Significance in Seeing," by Matthew Luckiesh and Frank K. Moss (*Journal of the Franklin Institute,* Vol. 220, No. 4, October 1935). Reference to this material will give a fuller understanding of the meaning of the values read from the meter.

METHOD OF CONDUCTING THE TESTS

The tests were run at the Oak Street Laboratory of the University of Minnesota. A corridor approximately 180 ft long and 15 ft wide was used. A set of headlamps was set up at one end, and the signs to be read were mounted on a tripod and moved to set points for observation.

It was desired to place the signs, with relation to the headlights, in approximately the same position they would have on the highway. In the testing area, the center line of the signs was set 13 ft to the right of the center line of the headlamps. This approximates the

condition of a car in the center of a 10-ft lane, where there is a 6-ft shoulder and the sign post is placed 2 ft outside the shoulder line. The centers of the signs were placed 0.5 ft above the filaments of the lamps.

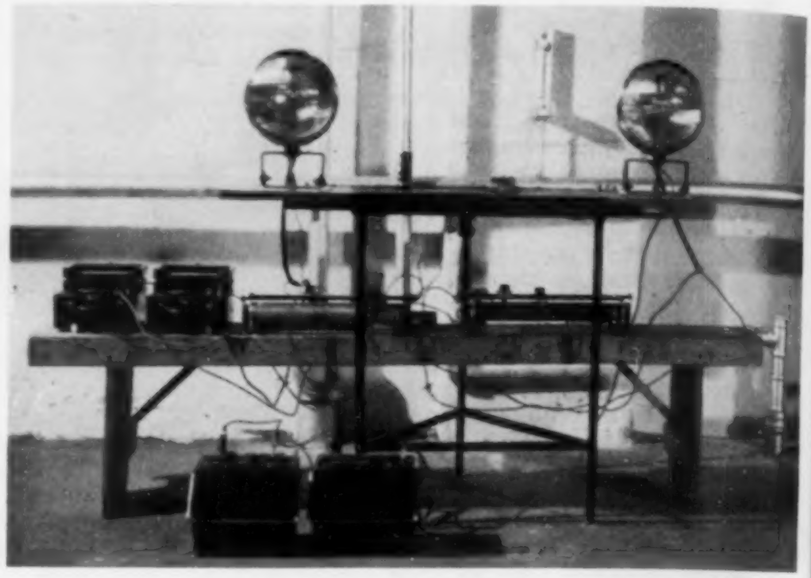
Tests were made on the signs at 50, 75, 100, 125, 150, and 175-ft distances. These measurements are on the center line of the headlamp beams. The signs were offset 13 ft to the right at each of these points, and the face of the sign was always vertical, and at right angles to the axis of the headlamps.

The position of the headlamps was located accurately and their alinement checked with an official headlamp testing screen before each series of tests. The lamps were 1934 General Motors Guide Tilt-Ray lamps with No. 1000, 32-cp bulbs, mounted 36 in. apart on a table. Current was provided by two 6-v storage batteries. These were changed for a newly charged set once during the tests. By means of the rheostats, the flow through the lamps was maintained at 3.82 amp.

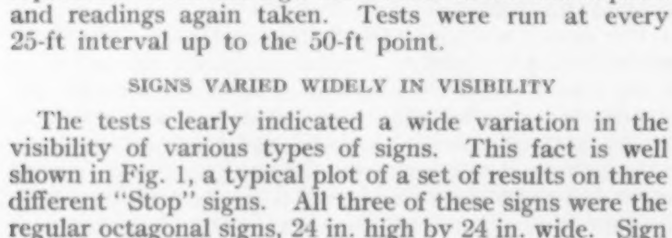
The procedure of running a test was as follows: A sign was set up at the 175-ft point and leveled. The corridor was then darkened and the headlamps thrown on high beam and the amperage adjusted. Each of three observers then took 5 readings with the visibility meter for the purpose of determining the mere presence of the sign, and then 5 readings for the purpose of understanding the message on the sign (that is, the reading of the word "Stop" on a stop sign). The lights were then dropped to low beam, the ammeters checked, and the process repeated. Next the sign was moved to the 150-ft point and readings again taken. Tests were run at every 25-ft interval up to the 50-ft point.

SIGNS VARIED WIDELY IN VISIBILITY

The tests clearly indicated a wide variation in the visibility of various types of signs. This fact is well shown in Fig. 1, a typical plot of a set of results on three different "Stop" signs. All three of these signs were the regular octagonal signs, 24 in. high by 24 in. wide. Sign "A" had white, $^9/_{16}$-in. reflector buttons on the letters of the word "Stop"; there were no buttons on the border. Sign "B" was covered, except for the area of the letters, with glass beads, 0.02 in. in diameter, which adhered to the yellow paint of the sign; the letters of "Stop" were painted black as in the other signs. Sign "C" was a plain painted sign. Tests on these same signs for reading "Stop" with the low headlamp beam, and for merely noting the presence of the sign with both the low and the high beam, gave sets of curves similar to Fig. 1. Tests were also run on "arrow" turn signs, and a like variation for different types of signs was found.



ARRANGEMENT OF LAMPS, BATTERIES, RHEOSTATS, AND AMMETERS



A VIEW OF THE CORRIDOR IN WHICH THE VISIBILITY TESTS WERE MADE

Each point of Fig. 1 represents the average result of 15 readings, 5 each by three different observers. Quite uniform results were obtained after some experience with the meter had been acquired.

It will be noted that the relative-visibility-distance relationships shown tend toward straight-line plots on a semi-logarithmic scale. This characteristic was common to all the signs tested.

Whereas the visibility of Signs "B" and "C" increases up to the 50-ft point, as shown in Fig. 1, that of type "A" has a maximum value at the 75-ft point. Some tests on this type of sign gave maximum readings for the 100-ft point. This is due to the fact that the angle of headlight rays to the sign becomes greater as the distance between sign and light decreases. A point is eventually reached for this type of sign at which the increase in visibility of the sign due to its being closer is less than the decrease of visibility caused by less reflected light reaching the observer. It is probably true, however, that the driver has read a warning sign before his car has approached this close.

For a simple comparison of different signs, ratios of relative visibilities can be taken off of plots such as Fig. 1. Unless the curves are exactly parallel, these ratios will vary somewhat according to the distance selected, although differences will not be great. For the data shown in Fig. 1, the ratio for the 100-ft distance is 5:00:2:19:1.20 (or 4:17:1.82:1.00). Such values give a rapid comparison of the visibilities of different signs.

Although the tests were not extensive, it is felt that the results show the feasibility of using the meter for sign visibility tests. It is thought that the numerical visibility values are of greater value than an individual's qualitatively expressed comparison.

Results of three observers indicated that the meter can be used with reasonably accurate results. These tests were practically the first experience of any of the observers in the use of the instrument.

The Low-Rental Housing Program and City Rebuilding

By Jacob Crane, M. Am. Soc. C.E.
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and Elbert Peets
Consulting Architect, Cleveland; Chief, Site Planning Section, Technical Division, U.S. Housing Authority

In discussing the program of the U.S. Housing Authority in relation to the future of our cities, Messrs. Crane and Peets pose three thought-provoking questions: (1) Will our cities give way to the forces of decentralization? (2) What will be the future of urban land values? And (3) if catastrophic dispersion of the city is to be prevented, what sort of housing and what orders of density should be provided? The policies of the USHA are not "frozen" in these respects, but certain general principles have been followed in keeping with the terms of the Housing Act. The authors emphasize that it is in connection with these broad questions of policy that the engineer's help is most needed—although many problems of detail also await solution. This paper was on the program of the City Planning Division at the Society's 1940 Annual Meeting in New York.

Our cities need rebuilding. Above all, the slum housing in them needs rebuilding. However it is done, whoever does it, the slums and near-slums in our cities must be torn down and new housing built. In hundreds of communities a start has already been made. Substandard buildings are being torn down, and sound housing for families of low income is being built, by many kinds of private and public instrumentalities. Hundreds of housing authorities are in fact rebuilding cities. Much of the money for this work has been borrowed from the USHA, supplemented by millions of dollars from the communities.

Engineers are doubtless familiar with the manner in which the U.S. Housing Authority gives assistance to, and cooperates with, local authorities. From Washington comes, as a loan, 90% of the cost of the project. The local authority chooses a site, retains architects and engineers, takes bids, and erects the project by contract. It employs managers, selects tenants, and operates the project. Throughout, the USHA gives such professional assistance and exercises such control as seems necessary in order to assure two things: (1) the low cost and low-rent character of the project, and (2) its permanent desirability as housing for low-income families. The USHA gives an annual cash subsidy. The state, county, and city ordinarily contribute through the remission of taxes. For every new dwelling built, a substandard housing unit must be eliminated by demolition, repair, or closing.

This, then, is the setup so far as the USHA is concerned. The FHA, which guarantees mortgages on privately constructed homes, is also a large participant in the housing program, though at higher income levels. The city of New York is building housing under a state law.

Taken all together, a housing program is the most powerful instrument now available for city rebuilding. It is in the use of housing as a means of reconstructing cities, and in the protection of this new housing by improvements in its surroundings, that local impetus and local knowledge are all-important. As to the dwelling units themselves, our general professional knowledge is rather well developed—most of the housing now being built with public participation is good housing. We have a fairly good general knowledge of site planning. But when housing is considered as a factor in the evolution of cities, as a means of rebuilding them—that is where the planning professions are less assured—that is where a great deal of clear and bold thinking is needed, and brave doing as well. The importance of fitting housing wisely into the evolution of the city cannot be exaggerated. In our choice of locations for projects and in our choice of densities and types of housing, we are committing ourselves and committing the future. If we make the right choices we shall help the next generation to save our cities. If we guess wrong, we shall add greatly to the heavy burden upon the future.

The problems are enormous and they are almost inextricably interwoven. For discussion, however, they may be stated in the form of three interrelated questions:

1. Will our cities give way to centrifugal forces—such as cheap fast transportation—and break up into neighborhoods spread over a large area?
2. What will be the future of urban land values, particularly in slums and blighted areas?
3. Assuming that we want to prevent a catastrophic dispersion of the city, what orders of density and what kinds of housing should be aimed at?

Decentralization Versus Central Rehabilitation

The late Henry Wright was almost bitter in his demand for a clear policy choosing between "outward growth and central rehabilitation." "If," he said, "we dash about in uncertainty, first doing a little slum clearance, then rehabilitating a section of blight, and then improving our methods of land subdivision and expansion, with no coordinated purpose, we are going to

In Harmony with Local Architectural Traditions
Robert Mills Manor, Charleston, S.C., Built by Charleston Housing Authority with USHA Aid


"BEFORE AND AFTER" VIEWS OF LAKEVIEW PROJECT, IN BUFFALO, N.Y.
Buffalo Municipal Housing Authority, with USHA Aid, Builds New Housing Providing Light and Air in Spite of High Density

end in chaos and a more general breakdown of our cities than anything suggested by our present difficulties."

Most of us might call this dilemma a choice between two evils. But in weighing the alternatives, we would agree that it would be a catastrophe if the wealth and labor, both public and private, that have been expended in building up the central sections of our large cities should be in large part wasted through the abandonment of the existing plant. It will, as Wright suggests, be extremely difficult to curtail suburban expansion. But in some cities such an expansion may in large part become unnecessary if a way can be found to restore livability to the inlying areas that have for a generation or two housed most of the working population. This does not mean that planning thought can confine itself to the center of the city. Modern technical advances have made city planning the servant of regional planning. Whichever of Wright's alternatives is chosen, it is plain that our cities will need broader powers of control than they now have. It is likely, for example, that if they controlled a much larger geographic area than at present, they would have the power and also the motive for a stronger and more rational planning of their physical form. It is obvious that private industry and commerce and transportation will be called upon to assist the city in such radical programs of rebuilding as this would imply, and that the engineers employed by private industry will likewise be called upon to correlate their work with the plans of the engineers who are serving the public.

THE PROBLEM OF ILLUSORY URBAN LAND VALUES

Our second question is obviously related to the first. Land values—it would be more accurate to call them "asking prices"—in most slums and blighted areas of big cities are still based on the expectation that the property shortly will be in demand for office buildings, hotels, and apartments. As a matter of fact, much of this land has use-value for only one thing, and that is housing. Without widespread reconstruction, however, the environment would not be attractive to the families, necessarily of a high income group, who could pay rents based on the present speculative value of the land.

A great deal of thought has been given to the question of how to reduce illusory land values. Enforced demolition is used abroad for the double purpose of eliminating insanitary dwellings and removing the income that enables the owner to hold the land out of its natural use-market. The so-called "decanting" of populations to outlying areas, or to high-density housing projects in or near the slum areas, has also been advocated and tried. Rezoning, to take slum and blighted areas out of commercial and industrial zones, is being studied in many cities. Downward revision of assessed valuations and the "graded tax" and "single tax" are also being considered. Such measures as these must be used to break through the Maginot Line of speculative land values that now stops most campaigns of city rebuilding before they begin.

AT WHAT DENSITIES SHOULD WE BUILD?

Supposing, then, that cities are to continue to be cities more or less as we now know them, and that the land-value barrier, which now restricts our freedom of choice in the location and design of housing, is somehow broken down, our third question becomes relevant. What kind of housing, or, to express it in a different way, at what densities, should we build?

Professional judgment, interpreting facts concerning employment, transportation, the cost of servicing, as well as the less mensurable considerations of healthfulness, amenity, and local traditions, will certainly evolve formulas adapted to the various districts of the various cities and types of cities. There may be differences of tendency here, between the housing planners and the city government—particularly the city engineering and maintenance departments. The city engineer will naturally want to see the existing plant put to fairly full use. The housing people will emphasize the danger of obsolescence in high densities—and that is a serious factor. Low-rent housing cannot be amortized in ten years, as a filling station might be. It is necessary to take a long view. Present population trends raise the question whether most cities will attract enough people to fill out their present framework. It definitely looks as if it would be playing on the safe side to hold densities down—remembering of course that the expression "low density" means one thing in New York and quite a different thing in smaller cities and towns.

Perhaps it will be asked what the policy of the USHA is in regard to the three basic questions just considered. Neither the provisions of the Housing Act of 1937 nor the current policies of the Authority, freeze these policies. The act requires the "equivalent elimination" of slum dwellings, but the new housing is not required to be on slum sites. The cost limitations are so expressed as not

to be strongly weighted for or against high densities. However, the whole situation does constitute in practice a limitation on the land cost per dwelling unit. True, the Housing Act itself does not state such a limitation. But it does limit the amount of money the Authority may spend, and the whole spirit of the Act very plainly requires that the Authority house just as many families as it possibly can with the fund set up. Since that sum will rehouse only a small fraction of the families now living in substandard dwellings, it is obviously good sense to begin with the fraction that can be housed without diverting too much money into land purchase. This is particularly true in view of the fact that the annual subsidy is based on a sum that includes the cost of the land.

It is not meant to imply that land cost of itself is a bugaboo to the project budget. In all cases the total cost, including such items as pavements and all utilities, is the sum that turns the decision for or against a downtown built-up site as compared with a vacant suburban site at much lower land cost per square foot. What is anathema, however, is any hint of "bailing out" distressed real estate at public expense merely for the sake of bailing it out.

We in the USHA all hope and believe that the cost of land will gradually become less and less a deciding factor in determining the location of publicly aided housing projects. We subscribe to the resolution passed by the National Association of Housing Officials at its December 1939 meeting, the tenor of which is expressed in these sentences: "The density of dwellings should primarily be determined on merits for living purposes, and should not be graded solely according to the cost of land . . . . High density in housing is injurious to the community both by bolstering up a false estimate of value, and by reducing the area that might be redeemed from blight." These quotations state, we believe, a sound policy, although the spirit of the law under which we are working, along with the present status of public opinion concerning subsidized housing, seems to suggest that most projects of this first program be located on land that permits a thoroughly livable density without producing a very high land cost per dwelling unit.

HELP OF ENGINEERS NEEDED

It should be emphasized that the broad questions of policy—the various relationships of housing to the living and evolving texture of the city—are precisely the questions that need the help of engineers, as participants in local thought and action. The professional men in the USHA, and also in the FHA and other federal agencies, regret that they are as yet able to do so little in the way of working with local housing authorities and planners on their long-range general plans. I refer to plans showing what the city will look like, perhaps, in 1970—not, it goes without saying, the fanciful fairyland pictures we used to make back in 1920, when the unending growth of population was assumed to be a natural phenomenon, but realistic plans for things we think really can be done. Plans like these must be made locally; the power to carry them out will not be there if the power to make them is not there.

NARROW, DEEP HOUSES IN CROWDED ROWS (UPPER RIGHT) CONTRASTED WITH THE MORE OPEN DEVELOPMENT OF A NEW HOUSING PROJECT AT ALLENTOWN, PA.

A HOUSING PROJECT PLANNED IN RELATION TO A PLAYGROUND, BUFFALO, N.Y.

Willert Park Project, Built by Buffalo Municipal Housing Authority for Negro Tenants

Perhaps it will be a relief to leave these broad considerations—things that must be done but which will require almost superhuman wisdom and energy to plan and accomplish—and to speak of traffic routes, superblocks, and playgrounds, things we know much better how to do. Our master city plans may not be carried as far or substantiated as completely as we could wish, but they usually provide for the essentials of such elements as traffic circulation and public open spaces, and they are supplemented by zoning plans that are at least much better than none at all. These are at present our best guides to city rebuilding, and the housing program should be correlated with them. It is a basic policy of the USHA to urge local housing authorities to bring the city engineers and city planning officials into the selection of sites for housing and into the preparation of site plans. A big project often gives an opportunity to realize a good piece of a forward-looking city plan. This is a fine thing in itself, and it is a fine thing as a demonstration of what skilled planning can do. A well-planned project will often show up the deficiencies of a neighborhood and may indirectly bring about other improvements, such as additional recreation facilities. The housing officials will add a great deal of strength to the forces fighting for better streets, better transportation, and a cleaner atmosphere, for they know that their work will be a failure unless the city can be made safe for housing.

In all the details of site planning, housing needs the help of engineers. We need well-designed superblocks that will demonstrate the advantages of the modern specialized street—as compared with the old type that tried to perform both residential and traffic functions. We need utility systems that will solve the puzzle of combining low first cost with low maintenance cost. We need someone to design a cheaper sewer manhole, and someone to invent a perfect playground surface. We need a good cheap fence, and we need a perfect garbage-collection and waste-disposal system. We need new ways, sound standards, wise policies. We need the help of all the planning professions—but especially that of the engineers—as professional men and as citizens, in meeting the complex problems of housing and city rebuilding.

Studies of a Near-Maximum Storm at St. Louis

First of Two Groups of Papers on Hydrological Investigations at Washington University

By Harry Kroeger, Henry I. Stewart, J. K. Bartlett, *and* T. G. Pfiffner
Members of Washington University Student Chapter, Am. Soc. C.E.

With an Introduction by W. W. Horner, M. Am. Soc. C.E.
Professor of Hydraulic and Sanitary Engineering, Washington University, St. Louis, Mo.

Introduction

By W. W. Horner

The two papers which follow set forth results of fundamental importance to the profession, developing from hydrologic-hydraulic studies undertaken by Student Chapter members of the American Society of Civil Engineers in connection with senior civil engineering work in hydrology at Washington University.

The first paper presents a detailed analysis of an unusual storm. The high spot intensities that occurred in this storm for durations of 15 min to an hour or more are on the order of 50% greater than those shown on Yarnell's 50-year frequency curve, and probably are representative of frequencies of occurrence in a particular restricted region of from 200 to 500 years. The storm is, therefore, a near maximum for the upper Mississippi Valley.

In this case, the opportunity was unusual in that the existence of a large number of recording gages made it possible to segregate intensities by 15-min periods with respect to areal distribution. The final graphs present the variations of intensities by 15-min periods over areas of 300 sq miles. They also show the variation for the mean of the 15-min and 30-min periods and for periods of 45 and 60 min. The difference in the use value of the two types of graphs should be carefully noted, as one set presents the areas over which a particular intensity is equaled or exceeded, and the companion line shows mean intensity over the corresponding area.

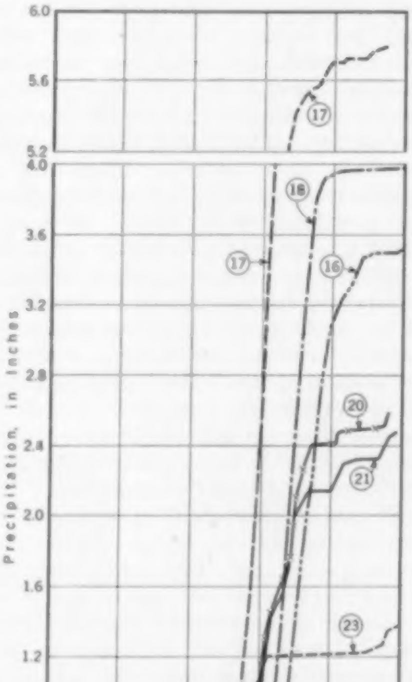


Fig. 1. Mass Curves, Rain of August 25, 1939

Numbers of Recording Gages Shown in Circles. For Location See Fig. 2

So far as the writer knows, the only other published extensive study of this kind was that presented by Frank A. Marston, M. Am. Soc. C.E., in the Transactions of the Society (Vol. 87, 1924, page 535).

In the second of the following papers it is shown how the type of precipitation information developed in the first paper, together with other available information with respect to infiltration capacity, may be applied through strictly hydraulic methods to determine the probable stream-flow hydrograph for a rural drainage basin of 4 sq miles. The infiltration capacity values made use of here are those derived under another investigation from data made available at the Edwardsville research station of the Soil Conservation Service.

Utilization of an available unit hydrograph of excess rainfall for 27-acre units is not essential to the general application, but made unnecessary the attempt to evaluate channel storage for the smaller fingers of the channel system.

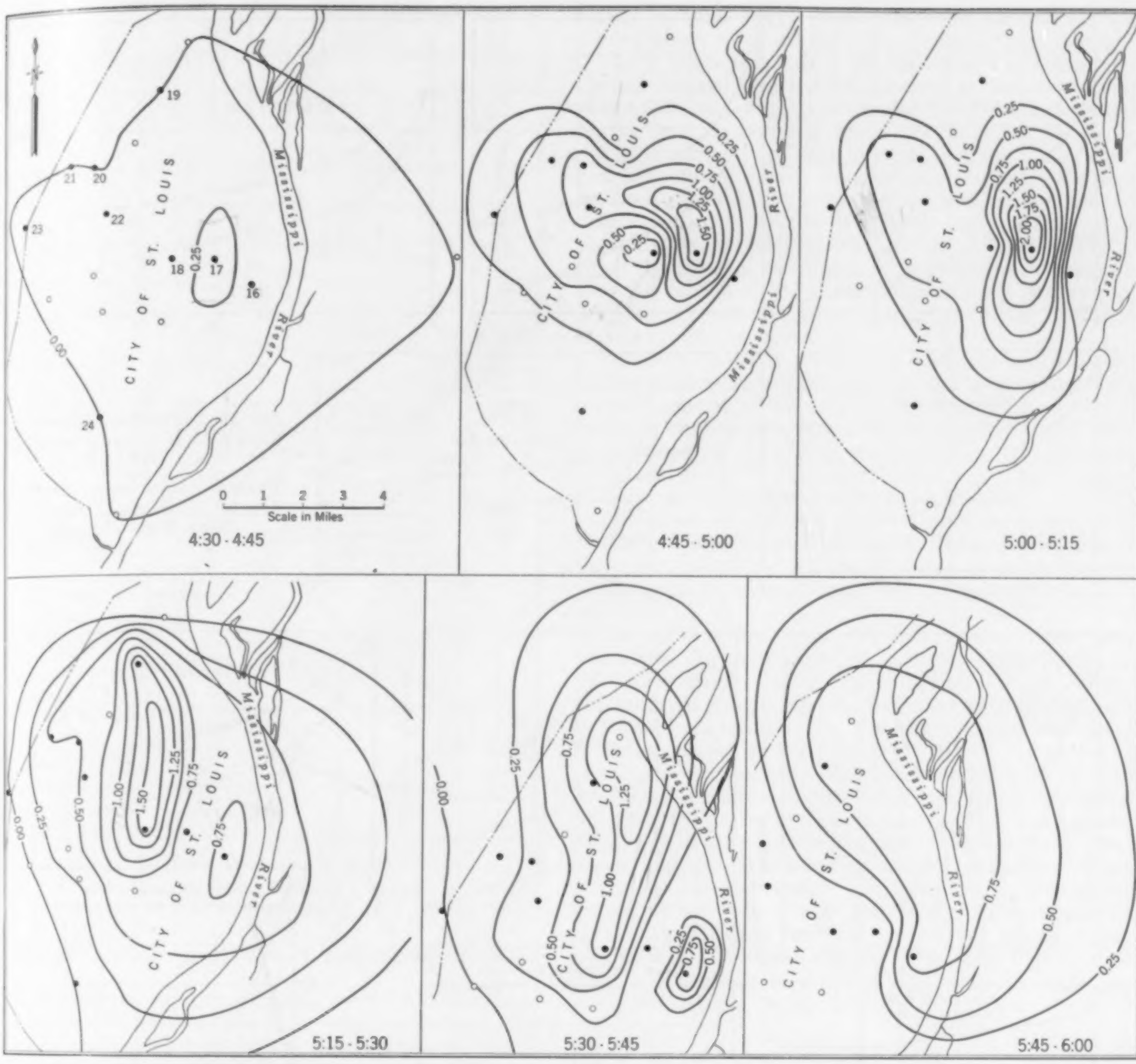
The application of the channel storage method to the main channel system might have been further refined by the development of stage-discharge and stage-storage graphs, separately for the rising and falling sides of the hydrograph. This refinement, however, was not possible within the time limitations of the application. The lack of it, in all probability, introduces no considerable error in the peak rate of channel outflow, although its use might have somewhat modified the shape of the outflow hydrograph.

This type of application is much more sensitive to the best choice of the Manning n coefficient for the channel reach adjacent to the control section. At the writer's suggestion, an n of 0.030 was used as reasonably representative of existing conditions. It is interesting to note, however, that if the lower part of this valley had been densely overgrown, so that an n of 0.050 or 0.060 might have been representative, the peak flood runoff would possibly have been only two-thirds of that shown; whereas if this reach had been fully cleared and developed, as smooth grass pasture, down to the stream margins, an n as low as 0.020 might have been applicable and the resulting flood peak might have been 30 to 40% higher than that shown. The clearing and smoothing out of cover in such small valleys as this may be responsible for a very great increase in local flood runoff, and may be responsible to a considerable degree for the higher flood rates that are being recorded in drainage basins of considerable size.

Depth-Area Relationship for an Unusual Storm in St. Louis

By Harry Kroeger *and* Henry I. Stewart

On August 25, 1939, the territory in and around St. Louis experienced one of the heaviest rainfalls in its history. An all-time high of 5.02 in. was recorded



at Garrison and Lucas streets between 4:35 and 5:35 a.m. This was the maximum rainfall for any 60-min period of the storm, and exceeded by 1.4 in. the previous record of 3.6 in., which fell at the same station on August 24, 1918. The maximum rainfall of 3.92 in. for a 30-min period exceeded any previous record of rainfall in the St. Louis area, surpassing even the record for any previous 60 min.

Although the rainfall was most intense at the Garrison and Lucas station, where 5.79 in. fell during the storm, it was excessive throughout the entire St. Louis area. The rain began in the southwestern portion of the city and traveled in a northeasterly direction. The Eichelberger and Morganford station, in south St. Louis, recorded the first rainfall at 1:43 a.m. The rain continued at intermittent periods at this station until 7:05 a.m.

The purpose of this paper and accompanying graphs is to present data showing the relation of rainfall depth to the area covered—a subject on which there is a dearth of information. It is hoped that the facts presented here will be of help to other investigators in drawing their own conclusions. An effort has been made to prepare the records so that they may be compared or combined

FIG. 2. (ABOVE) AREAL DISTRIBUTION OF RAINFALL, BY 15-MIN INTERVALS FROM 4:30 A.M. TO 6:00 A.M.

Black Circles Show Locations of Recording Gages; Open Circles, Location of Standard Gages. (Records of 19 Gages Outside the Limits of These Maps Were Also Consulted in the Study.) On Map in Upper Left, Numbers on Recording Gages Correspond with Those in Fig. 1

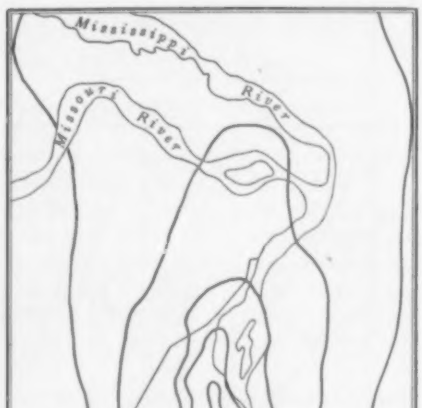


FIG. 3. (AT RIGHT) TOTAL RAINFALL, STORM OF AUGUST 25, 1939

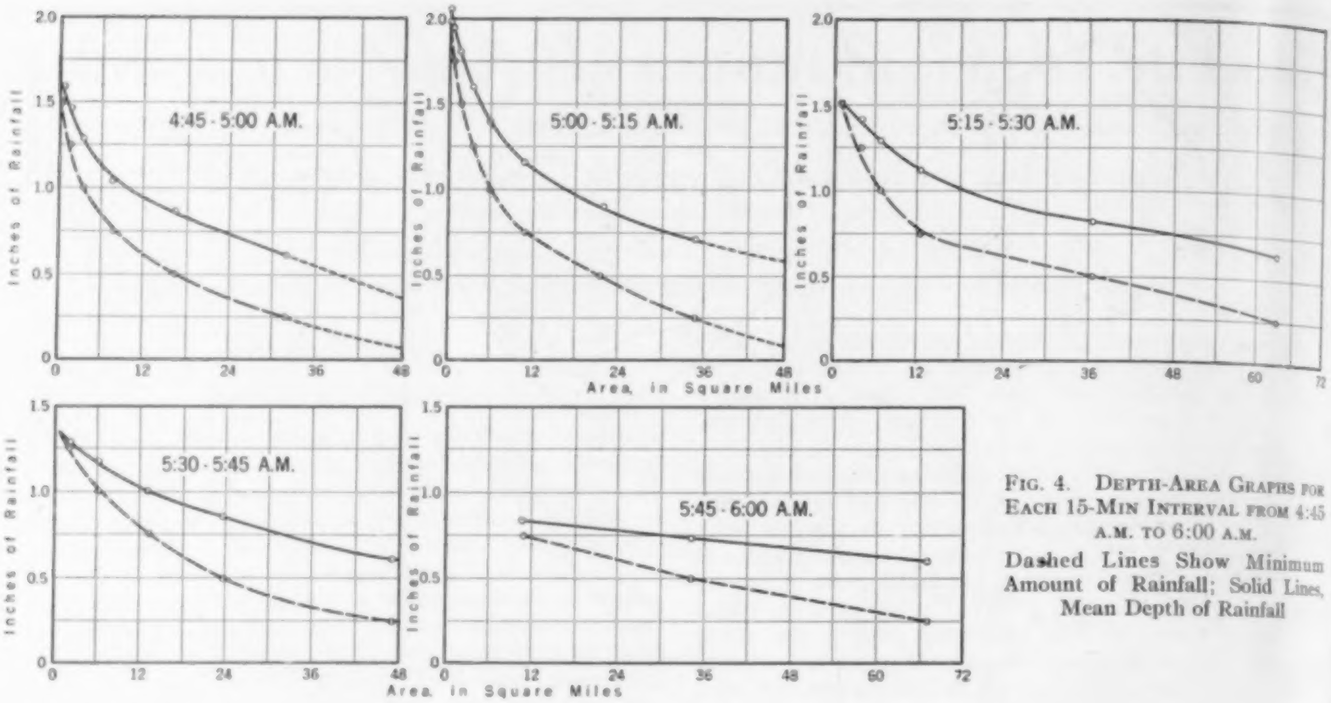


FIG. 4. DEPTH-AREA GRAPHS FOR EACH 15-MIN INTERVAL FROM 4:45 A.M. TO 6:00 A.M.
Dashed Lines Show Minimum Amount of Rainfall; Solid Lines, Mean Depth of Rainfall

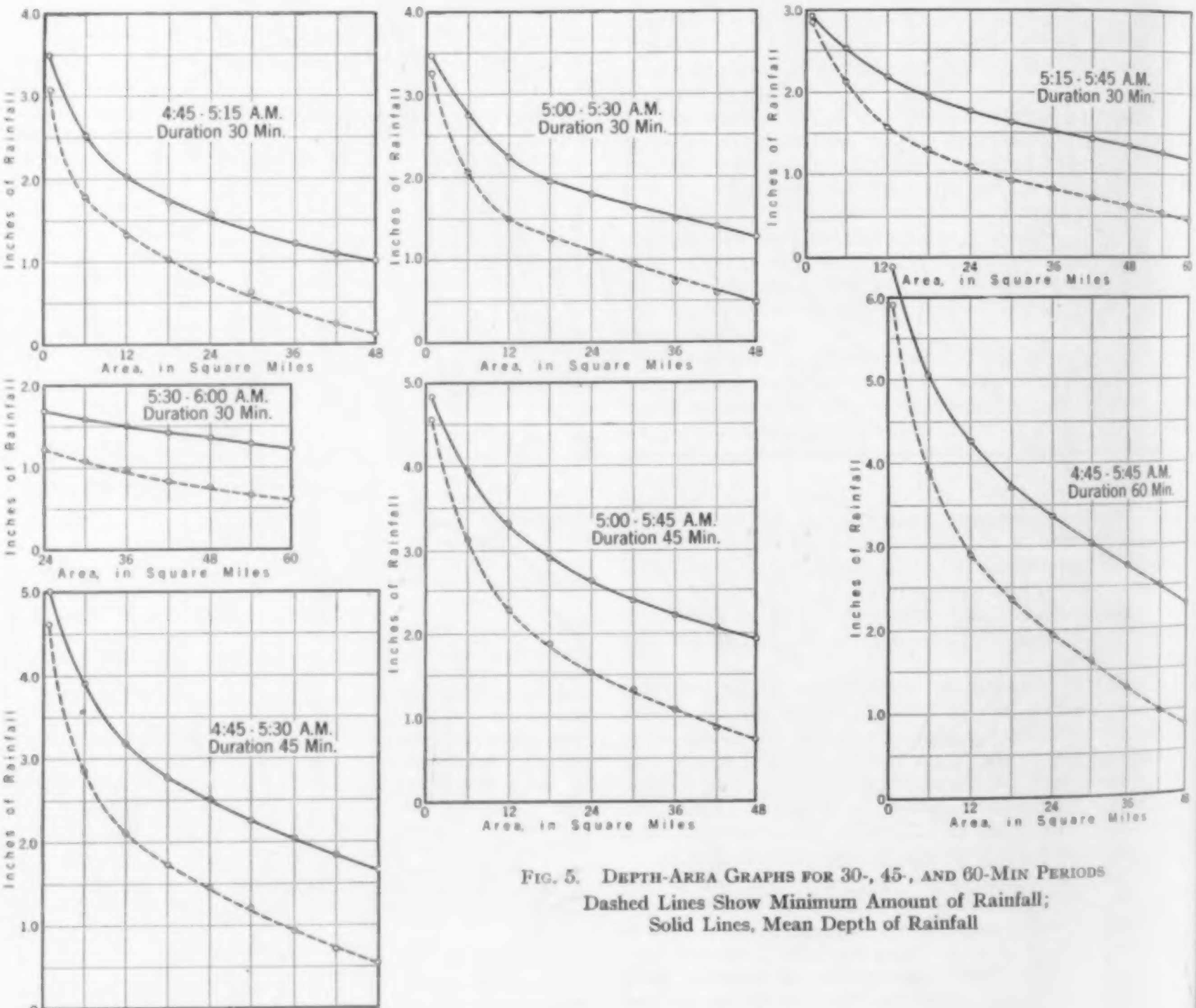


FIG. 5. DEPTH-AREA GRAPHS FOR 30-, 45-, AND 60-MIN PERIODS
Dashed Lines Show Minimum Amount of Rainfall; Solid Lines, Mean Depth of Rainfall

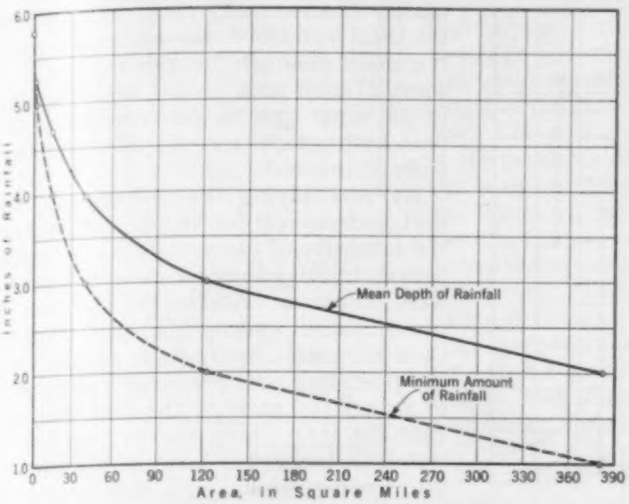


Fig. 6. Depth-Area Graph for Entire Storm of August 25, 1939

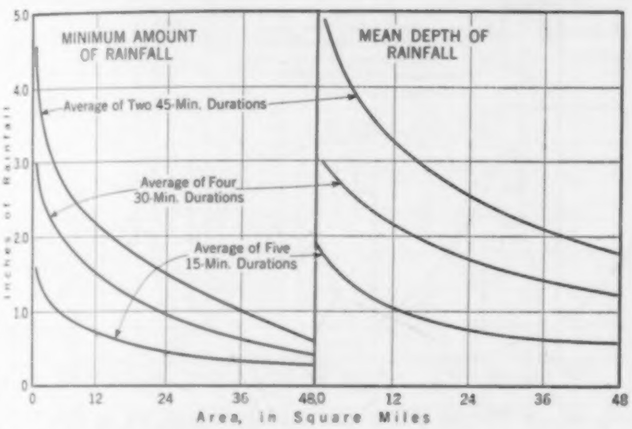


Fig. 7. Depth-Area Graphs—Average Curves for 15-, 30-, and 45-Min Periods Shown in Figs. 4 and 5

with other measurements which may be accumulated later.

Chart records for this analysis were made available through the courtesy of the U.S. Weather Bureau, the City of St. Louis, Washington University, St. Louis University, and the U.S. Soil Conservation Service Station at Edwardsville, Ill. In all, there were 36 gages in the area under investigation, distributed from Collinsville, Ill., on the north, to the southerly limits of St. Louis on the south, and from St. Louis Airport on the west to Edwardsville, Ill., on the east. Eleven of these gages were of the recording type; the rest were standard.

From these records, data sheets were made up containing the time of rainfall, amount of rainfall, and intensity of rainfall in inches per hour. The time was broken up into intervals to show each change in intensity. The accumulated depth and the depth for each time interval were recorded on the data sheets. These sheets are not reproduced here, but information contained on them has been shown in graphical form.

Figure 1 is a mass diagram showing the accumulated depth, the duration, and the relative progression of the rainfall at each recording gage station.

Maps of the St. Louis area showing the location of the recording and standard gage stations were used to show the relation of the rainfall depth to the area covered. The six maps of Fig. 2 indicate the amount of rainfall for successive 15-min intervals between 4:30 a.m. and 6:00 a.m., and Fig. 3 shows the total rainfall for the storm, which extended somewhat beyond those limits.

These maps were made by recording the amount of rainfall for the proper time interval at the location of each of the recording gage stations, and then interpolating for the corresponding amounts of rainfall at the standard gage stations for that interval of time. The interpolated values for each standard gage station were next summed up and the total amount compared with the values recorded by the standard gages. The interpolated amounts were then corrected proportionately to equal the total of the standard gage values. Isohyetal lines for each 0.25 in. of rainfall were then drawn proportionately between the stations, and the included areas were planimetered.

For each 15-min interval, the areas on which a particular amount of rainfall was equaled or exceeded were plotted against those rainfall amounts (Fig. 4, lower curve in each pair). Then the minimum rainfall over these areas for durations of 30, 45, and 60 min was calculated from the 15-min curves of Fig. 4 and plotted as shown in Fig. 5 (lower curve in each pair).

The mean rainfall for each of these areas was next similarly computed and plotted, to show the relation of the mean rainfall depth to the area covered, for the various time intervals (Figs. 4 and 5, upper curve in each pair).

The total rainfall areas for increments of one inch and above were also obtained from the rainfall map for the full storm. Curves showing the relation of the minimum rainfall depth and the mean rainfall depth to the total area covered for the whole storm were then plotted as shown in Fig. 6.

Average curves were calculated for each set of 15-, 30-, and 45-min minimum and mean curves by taking the sum of the ordinates of each set of curves and dividing this sum by the number of curves in the corresponding set. These curves are plotted in Fig. 7.

The area of the rainfall in excess of 1 in. was about 382 sq miles. There were not enough recording raingage stations in the outlying territory of the St. Louis area to furnish information on just where the rainfall ended. Therefore no attempt was made to show the total area covered by the storm.

Probable Maximum Flood Flow from a Small Watershed

By J. K. Bartlett *and* T. G. Pfiffner

The spillways of dams must be designed to take care of the maximum flood flow that can be reasonably expected. The problem in the present study was to find the hydrograph of stream flow through a control section just above a proposed reservoir, computing flood flow from infiltration and channel storage. After the discharge has been determined by the method proposed here, it is a simple matter to determine the necessary capacity of the spillways.

The proposed dam is to be constructed in southern Illinois, and the reservoir is to be supplied by runoff from a 2,740-acre watershed. The rain of August 25, 1939, at St. Louis, discussed in the preceding paper, exceeded the 50-year frequency curve by more than 50%, which would make it a rain of a frequency of 200 to 500 years. It is therefore considered safe to assume that this rain would give the worst conditions that could be expected, and it was accordingly transferred onto the watershed

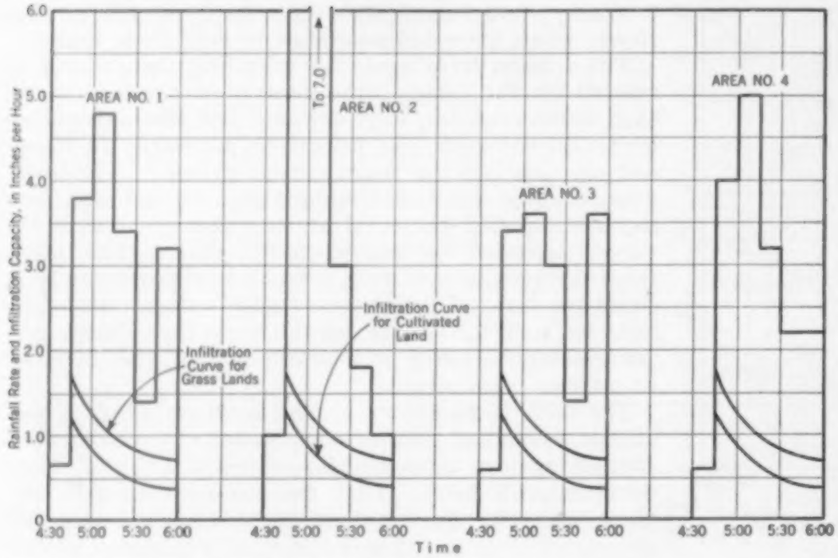


FIG. 8. HYSTOGRAMS OF RAINFALL OF AUGUST 25, 1939 (TRANSFERRED TO WATERSHED UNDER INVESTIGATION), WITH INFILTRATION CURVES

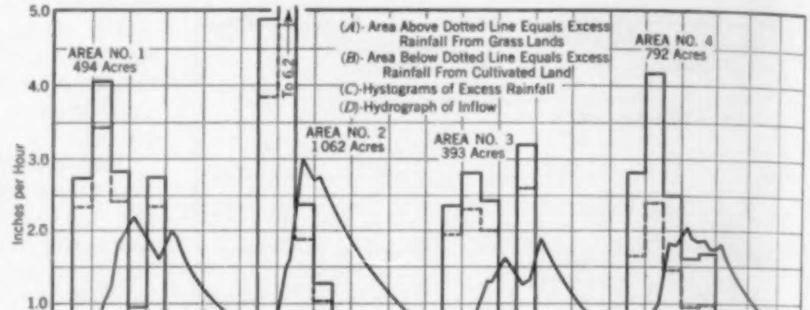


FIG. 9. HYSTOGRAMS OF EXCESS RAINFALL, AND HYDROGRAPHS OF INFLOW INTO MAIN CHANNEL SYSTEM FOR EACH SUB-AREA

of the proposed dam (without rotating the axis of the path of the rain). This was done by using the rain charts (Figs. 2 and 3) of the preceding paper. The region of greatest total precipitation was centered on the watershed in such a way as to produce the greatest channel flow. After the points of greatest total rainfall had been located, charts of each 15 min of the storm were placed on the watershed, and by interpolation between the isopluvial lines the mean 15-min intensities on each of the four sections into which the watershed had been divided were found. (Division into sections was necessary because the variations in the iso-pluvial lines of the 15-min charts were too great to justify the application of a mean intensity to the whole watershed.) From this information, hystograms showing the 15-min intensities for the duration of the rain were plotted for each of the four sections. (See Fig. 8.)

It was necessary next to determine the amount of infiltration to be expected with the type of land in question. Available for use in this connection were infiltration capacity curves from experiments on the same type of soil, made at the Edwardsville, Ill., research station of the Soil Conservation Service. Two such curves are plotted on each of the hystograms of Fig. 8, the upper one being for uncultivated land, and the lower one for cultivated land. By subtracting the ordinates of the infiltration capacity curves from the ordinates of the hystograms of rainfall, the ordinates for the hystograms of runoff from each type of land were obtained. The percentages of cultivated and uncultivated land in the watershed were then determined from aerial maps, and the runoffs from the two types of land were multiplied by the corresponding percentages and added together to give the hystograms of surface runoff for each of the four sections as shown in Fig. 9.

A unit hydrograph of runoff from 0.25 in. of excess rainfall in 15 min on a 27-acre watershed of the same type as that considered here was computed from data obtained from the research station. (See Fig. 10.) The entire area was divided into 100 watersheds of approximately 27 acres each. Any rain falling on the total watershed was assumed to reach the main channel through the outlet of some 27-acre area, in the same way and in the same time as was required in the unit hydrograph for the 27 acres originally computed.

By multiplying the ordinates of the unit hydrograph for the 27-acre area by the intensity of excess rain for a 15-min period, hydrographs for each such period were obtained. Adding the ordinates of each 15-min hydrograph, and starting each successive hydrograph 15 min after the preceding one, produced hydrographs of runoff for each of the four sections. (See Fig. 9.) These final hydrographs of runoff in inches per hour were converted into hydrographs in cubic feet per second, and added to give the total hydrograph of runoff for the entire area (Fig. 11). This rate curve was in turn transformed into a mass curve of inflow into the main channel system (Fig. 12).

With the inflow hydrograph into the channel system determined—excluding the channels contained in the 27-acre units—the water was routed through the main channels and a hydrograph of flow through a control section into the reservoir was developed.

The control section was taken at the estimated upper end of the reservoir, and its cross section was plotted. Sections of channels at the outlets from the 27-acre areas were also required; and since the only contour map available did not show the cross sections in detail, they were assumed uniform and equal to that at the outlet of the 27-acre area at the research station. Since the depth of the upper section at bank-full flow was one-fourth of that at the lower control section, a rise of 0.25 ft at the small outlet was used for every foot of rise in stage at the lower control section. The length of the main channel was measured, and the volume of storage for each foot of rise in stage at the control section was

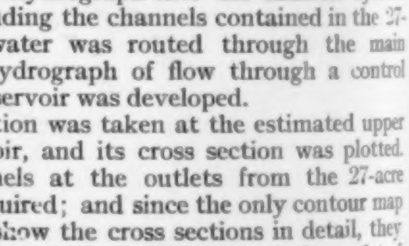


FIG. 10. UNIT HYDROGRAPH FOR 27-ACRE WATERSHED, 0.25-IN RAINFALL EXCESS IN 15 MINUTES

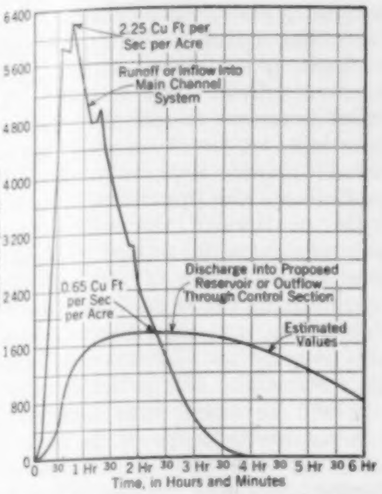


Fig. 11. Total Hydrographs of Inflow Into Main Channel System and Outflow Through Control Section

computed, by multiplying the average of the end areas by the length of the channel. The storage in the branches of the main channel was found by considering them as proportional parts of the main channel. A stage-volume curve for the entire channel system was then plotted as shown in Fig. 13.

The slope of the channel through the control section was found from the contour map, and by use of the Manning formula, with n equal to 0.030, the discharge through the section was computed for various stages to give the stage-discharge curve shown in Fig. 13. The hydraulic slope was assumed constant during the filling and discharging of the channels. It would actually vary somewhat, but it was felt that the assumption would not involve too much error.

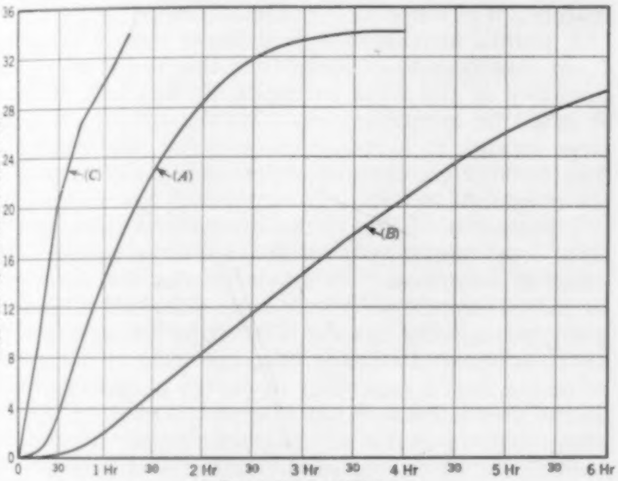


Fig. 12. Mass Curves of (A) Inflow Into Channel System, (B) Discharge through Control Section, and (C) Excess Rainfall

By the system of proportioning between the mass curve of inflow and the storage and discharge curves, the mass curve of outflow through the control section was drawn (Fig. 12), and from this the hydrograph of discharge was plotted (Fig. 11). A time increment of 10 minutes was used to obtain the increase in inflow to be proportioned between storage and discharge. The procedure for such computations is well known and need not be discussed here.

In analyses of this kind, which depend largely upon judgment, errors are expected but they should not be great enough to nullify the value of the computation. The sharp break in the stage discharge curve shown in Fig. 13 was due to the shape of the channel, which abruptly widened out at the top of the bank, causing the channel flow to become valley flow. Since it would be impossible for the water to act in such a manner, a smooth curve was assumed and used for the computations. The error introduced here should not be too large.

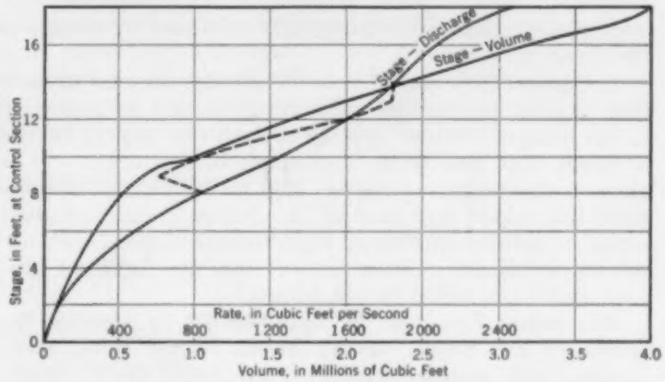


Fig. 13. Storage in Channels and Discharge Through Section

The interesting thing about the computations is the large amount of storage in the channel system at the peak of the outflow hydrograph. Very few computations for flood flow on small watersheds have been made, and it is felt that this procedure may help in the design of small dams and spillways.

ENGINEERS' NOTEBOOK

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Notes on Response of Mississippi River to Channel Changes

By W. E. Elam, M. Am. Soc. C.E.

Assistant Engineer, Mississippi Levee Board, Greenville, Miss.

The program of cutoffs and other means to expedite the movement of Mississippi River flood waters to the sea has presented one of the most baffling problems that ever confronted the engineering profession. The reason for this is understandable. Prior to the use of laboratory investigations to segregate the various phenomena, the engineers engaged on this work had to observe the action of the river and guess the cause of the various effects they saw. Being human they frequently failed to connect an effect to its proper cause and, in the case of cutoffs or channel shortening, took measurements from the wrong starting point. More-

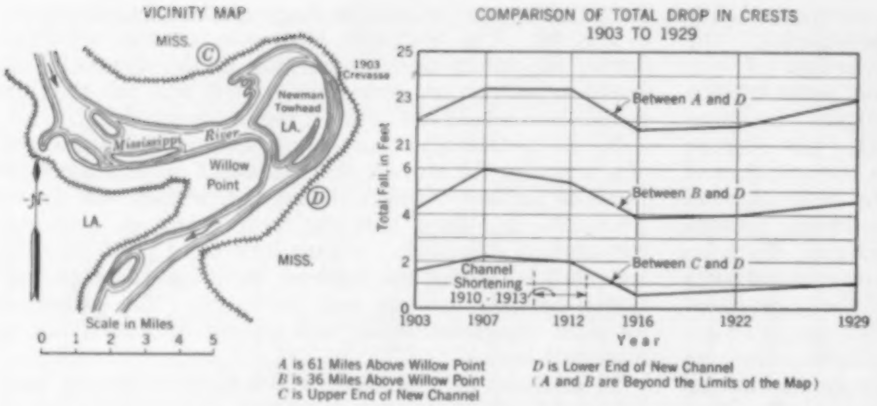


FIG. 1. WILLOW POINT SHORTENING EFFECT

over, observations were frequently confused by breaks in the levee.

The laboratory was able to determine very accurately that cutoffs, or channel shortening, caused no piling up in the channel below, and so settled one aspect of the problem that had been of concern to engineers. It is above a shortening, of course, that all the change in slope must take place, and that all the change in channel must occur in the readjustment to a normal slope. One unsolved problem is: How far will this development proceed and when will it be completed?

The writer has had the opportunity to observe the action of the river—caving banks, water lines, levee breaks, and channel changes—for over thirty years. It is interesting now to study some of this old history of channel and slope changes and compare it with the changes that have taken place as a result of the present program, and it may be of value in estimating the future development of the channel. The time and extent of development of channel changes cannot be determined in the laboratory. These data have been assembled in an effort to help solve the perplexing question as to how long it will take to produce what final result.

In addition to several levee breaks in the Mississippi Levee District and across the river in both Arkansas and Louisiana, a channel shortening occurred about 30 years ago near the lower end of the district (Fig. 1), and about 24 years ago a spur dike was constructed on Ashbrook Point to prevent a cutoff (Fig. 2). Considerable data were collected, of water levels particularly, in both these instances. The channel shortening occurred by the enlargement of an old chute across Willow Point, about 30 miles above Vicksburg, between 1910 and 1913. This was not exactly a cutoff, but the action was the same except that it took somewhat longer to develop. Ashbrook Dike was constructed in 1916–1917. The Mississippi Levee Board for many years followed the practice of running levels after each major flood to have a record of the water line at the crest of the flood. A comparison of the water lines in the vicinity of each of these occurrences that were taken before and after the changes should throw some light on the question of time of development.

The method selected to show the effect of the Willow Point channel shortening was to plot the drop of the river in years of major floods from points at the upper and lower ends of the shortening and points 36 and 61 miles above the cutoff. These differences in elevation are shown on Fig. 1 for the floods from 1903 to 1929. The 1903 differences should have some explanation. A break in the levee occurred opposite Willow Point in 1903 and between the upper and lower ends of the portion of the main channel that was later by-passed. Thus we have a comparison of a break and a shortening in the same location. The effect appears to have been nearly the same in each case, but space will not be taken to go into this in detail.

It will be noted that little change occurred in the slope of the river between 1907 and 1912, notwithstanding that the river was making considerable headway in the latter part of this period in cutting across Willow Point without showing any great loss of head. There was a major flood in 1913, also, but two levee breaks occurred within 50 miles, and above Willow Point the water lines were not of enough value to run. This flood no doubt completed the scouring out of the new channel sufficiently to give it the maximum effect of approximately 2 ft of lowering over the 1916 flood.

A gradual increase of slope is shown from 1916 to 1929. I am unwilling to concede that this is the oft-claimed tendency of the river to regain its loss after a cutoff. It could be as easily caused by the river's not having slope enough to keep the channel full size, and by the deposition in the channel of detritus that would increase the resistance to flow.

The conclusion that can be drawn from this is that the total drop caused by a cutoff is obtained as soon as the cutoff is completed. It is possible that the effect could be shown entirely with little more than half of the water going through the cutoff. The slight lowering shown in 1912, however, indicates that the drop is not evident while the river is expending its energy in making a cutoff. These conclusions will not apply where the effect of many cutoffs is to be reckoned with. In such case another factor enters, as the entire river is speeded up and channel enlargement begins to affect the reaches between the cutoffs. It should be safe to assume, by analogy, that the scouring noted after the 1937 high water will not occur to the same extent in the next high water of the same magnitude, nor will the velocities be quite as great. In the meantime, it may become more and more difficult to make the river do its developing

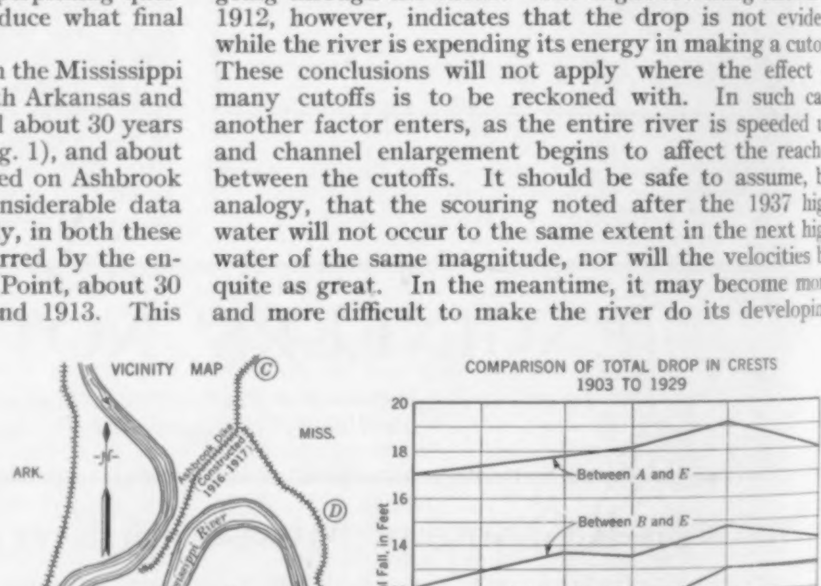


FIG. 2. ASHBROOK DIKE EFFECT

work in the right spot and in the proper amount. However, with the data and experience being accumulated every day it will certainly be possible to do so.

The effect of the building of Ashbrook Dike in 1916 and 1917 is shown in the same manner in Fig. 2. The dike was of course exactly the reverse of a cutoff, and its effects as plotted show this clearly when we apply a little more guesswork to the chart. The gradual increase of slope from 1903 to 1913 was caused partly by a break at the lower end of the Greenville Bends in 1903 that temporarily depressed the water level upstream. This probably scoured out the channel (which later gradually deteriorated) for many miles above, thus increasing the slope. However, the sudden increase of slope after 1916 is apparent until 1922. This shows that Ashbrook Dike acted as an obstruction in the channel by cutting off the flow of water that was bypassing Ashbrook Point. From 1922 to 1929 the slope dropped again, indicating that the 1922 water scoured out the channel around Ashbrook Point to a more nearly normal size. Space could be taken to point out the similarity of effect in both cases but it is sufficient to say that proof of this kind is more convincing when opposite situations are compared with like answers.

These instances indicate that the river responds very promptly to any change in length. So far as the water line is concerned, it could be said that the effect of any scouring out will be shown in the next major flood.

Reference is made to the article, "Flood Control Through Slope Correction," published in *Engineering News-Record* for June 28, 1928, and to a discussion by the writer on the symposium, "Flood Control with Special Reference to the Mississippi River," published in the TRANSACTIONS of the Society, Vol. 93 (1929), page 937. These articles also gave evidence that controlling the length of the river would control the water levels and that the river would promptly adjust itself to the new length.

In this connection it might be well to understand that the proper construction of the Atchafalaya outlet is the most importment element of this method of getting the flood waters safely to the Gulf. I have always considered it the primary element, and the cutoffs only as agents to pass the lowering upstream from this outlet.

Computation of Great Circle Azimuths and Distances for Air Flights

By DeWitt L. Reaburn, M. Am. Soc. C.E.

Project Engineer, WPA, Los Angeles, Calif.

This article describes a simple method for computing the great-circle azimuths and distances for air flights. It brings out no new principles; but, by assuming the earth to be a sphere equal in volume to the Clarke spheroid, it eliminates the use of complicated geodetic formulas and substitutes the well-known formulas of spherical trigonometry, which are assembled in the most convenient form for logarithmic or computing-machine computation.

The only data required for figuring the azimuth and distance are the latitudes and longitudes of the two airports, which may be scaled from local large-scale maps. The computations are quickly made and are well within the limits of accuracy required for aviation purposes.

The radius of a sphere equal in volume to the Clarke spheroid is 3,959 statute miles, and the length of one degree of the great circle is 69.10 statute miles, at sea level. In the polar triangle APB (Fig. 1), A and B are the points of known latitude and longitude, P is the pole, PC is a perpendicular from P to AB, and D is a point of known longitude on AB. The known parts are PA, the co-latitude of A; PB, the co-latitude of B; and P, the difference in longitude. The unknown parts are AB, the great circle between A and B; A, the angle with the meridian at A; B, the angle with the meridian at B; E, the spherical excess of APB; PC, the perpendicular to AB; AC, the great circle between A and C; PDC, the angle with the meridian at D; and PD, the co-latitude of D.

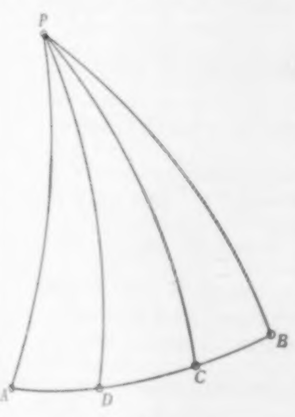


Fig. 1

The unknown parts are given by solution of the following formulas:

$$\cot \frac{E}{2} = \tan \frac{\text{lat } A}{2} \tan \frac{\text{lat } B}{2} + \cos P \quad (1)$$

$$\cos AB = \sin \text{lat } A \sin \text{lat } B + \cos \text{lat } A \cos \text{lat } B \cos P \quad (2)$$

$$\sin A = \frac{\sin P \cos \text{lat } A}{\sin AB} \quad (3)$$

$$\sin B = \frac{\sin P \cos \text{lat } B}{\sin AB} \quad (4)$$

$$E = (P + A + B) - 180 \quad (5)$$

$$\text{Azimuth } AB = (180 \pm A) \quad (6)$$

$$\text{Azimuth } BA = (180 \pm B) \quad (7)$$

$$\text{Distance } AB \text{ (in miles)} = 69.10 \times (AB \text{ expressed in degrees}) \quad (8)$$

$$\sin PC = \sin PA \sin A = \sin PB \sin B \quad (9)$$

$$\cos AC = \frac{\cos PA}{\cos PC} \quad (10)$$

$$\cos PDC = \sin CPD \cos PC \quad (11)$$

$$\sin PD = \frac{\sin PC}{\sin PDC} \quad (12)$$

$$\text{lat } D = (90 - PD) \quad (13)$$

$$\text{Azimuth } DB = (180 + PDB) \quad (14)$$

If P is greater than 90°, the second members of Eqs. 1 and 2 are minus. When co-lat A is larger than co-lat B, the angle B is larger than the angle A, and vice versa,

and in some cases it will be necessary to take the supplement of the computed angle. When the conditions of Eq. 5 are satisfied, the computations are correct.

Three examples will be worked out to show the application of the formulas. Latitudes and longitudes used here were obtained from small-scale maps published by the National Geographic Society.

Example 1. Given:

Latitude of New York	$= A =$	40°39'00" N
Latitude of Paris	$= B =$	49°53'00" N
Difference in longitude	$= P =$	76°06'00"

Required: Azimuth AB, azimuth BA, and distance AB.

Substituting in the formulas and solving, we get:

From Eq. 1:	Excess	$= E$	= 17°49'30"
From Eq. 2:	Great circle	$= AB$	= 52°00'12"
From Eq. 3:	Angle	$= A$	= 52°32'00"
From Eq. 4:	Angle	$= B$	= 69°09'30"
From Eq. 5:	Excess	$= E$	= 17°49'30" check
From Eq. 6:	Azimuth	$= AB$	= 232°32'00"
From Eq. 7:	Azimuth	$= BA$	= 110°50'30"
From Eq. 8:	Distance	$= AB$	= 3,591.4 miles

Therefore, the azimuth from New York to Paris is 232°32'00", the back azimuth is 110°50'30", and the great-circle sea-level distance is 3,591.4 statute miles. The actual distance traveled by the plane is $\frac{3{,}591.4\,(3{,}959 + h)}{3{,}959}$ statute miles, in which h is the elevation in miles, at which the plane travels.

Example 2. Given:

Latitude of Moscow	$= A =$	55°35'00"
Latitude of Fairbanks	$= B =$	65°05'00"
Difference in longitude	$= P =$	175°19'00"

Required: Azimuth AB, azimuth BA, distance AB, distance PC, distance PA, and distance PB.

Substituting in the equations and solving, we get:

From Eq. 1:	Excess	$= E$	= 00°42'18"
From Eq. 2:	Great circle	$= AB$	= 59°15'48"
From Eq. 3:	Angle	$= A$	= 02°17'50"
From Eq. 4:	Angle	$= B$	= 03°04'40"
From Eq. 5:	Excess	$= E$	= 00°42'18" check
From Eq. 6:	Azimuth	$= AB$	= 177°42'21"
From Eq. 7:	Azimuth	$= BA$	= 176°55'18"
From Eq. 8:	Distance	$= AB$	= 4,095 miles
From Eq. 9:	Distance	$= PC$	= 90 miles
(69.10 co-lat A):	Distance	$= PA$	= 2,378 miles
(69.10 co-lat B):	Distance	$= PB$	= 1,722 miles
	Distance	$= (PA + PB)$	= 4,100 miles

Therefore, the azimuth from Moscow to Fairbanks is 177°42'21", the back azimuth is 176°55'18", and the great-circle sea-level distance is 4,095 statute miles. The great circle crosses the 60th meridian at a distance of 90 miles from the pole, and the additional distance to fly over the pole is 5 miles.

Example 3. Given:

Latitude of New York	$= A =$	40°39'00" N
Longitude of New York	=	73°56'00" W
Latitude of Berlin	$= B =$	52°31'00" N
Longitude of Berlin	=	13°36'00" E
Difference in longitude	$= P =$	87°32'00"
Azimuth	$= AB =$	226°06'00"
Azimuth	$= BA =$	116°03'00"
Distance	$= AB =$	3,976 miles

Required: Latitudes and azimuths at longitude intervals of 5°, on the great circle from New York to Berlin.

Substituting in the equations and solving, we get:

POINT	LONGITUDE	LATITUDE	AZIMUTH DB
New York	73°56' W	40°39' N	226°06'00"
D-1	70°00'	42°20'.5	228°44'00"
D-2	65°00'	46°16'	232°16'00"
D-3	60°00'	48°43'	235°57'00"
...	...	...	...
D-11	20°00'	56°50'.7	268°21'00"
C	18°02'	56°51'.6	270°00'00"
D-12	15°00'	56°49'.5	272°32'00"
...	...	...	...
D-17	10°00' E	53°30'.7	293°11'00"
Berlin	13°36' E	52°31'	296°03'00"

From this tabulation, the great-circle course can be projected upon the map at any intermediate points. The great circle reaches its most northerly point at C, in latitude 56°51'.6 N and longitude 18°02' W, and the azimuth at this point is due East.

Slide-Rule Interpolation for Six-Place Trigonometric Functions

By B. J. GREULICH, JUN. AM. SOC. C.E.

ESTIMATOR, MIDSTATE CONSTRUCTION COMPANY, FRESNO, CALIF.

WITH the advent of the calculating machine, the use of natural trigonometric functions involving figures to six decimal places has become increasingly common. The ordinary set of trigonometric tables gives the value of the functions in increments of one minute, and thus some method of interpolation is required if the angular measure is to be expressed in units whose accuracy is equivalent to that of the tables. A convenient method of interpolation, requiring only the assistance of the slide rule, is given in the following paragraphs.

In Fig. 1, by inspection,

$$y = \sin\theta \qquad (1)$$

$$y + \Delta y = \sin(\theta + \Delta\theta) \qquad (2)$$

$$\text{and } \Delta y = \Delta\theta \cos(\theta + \Delta\theta) \qquad (3)$$

For purposes of interpolation, $\cos(\theta + \Delta\theta)$ is assumed equal to $\cos\theta$, since the error introduced is less than the allowable as long as $\Delta\theta$ is less than 1 min: Thus

$$\Delta y = \cos\theta \cdot \Delta\theta \text{ (approximately)} \qquad (4)$$

Adding Eq. 1 and Eq. 4, $y + \Delta y = \sin\theta + \cos\theta \cdot \Delta\theta$, and substituting in Eq. 2,

$$\sin(\theta + \Delta\theta) = \sin\theta + \cos\theta \cdot \Delta\theta \qquad (5)$$

To illustrate, let us determine the value of sin 28°24′43″, having available six-place tables of natural functions.

$$y = \sin 28°24' = 0.475624 \text{ (from tables)}$$

$$\Delta y = 0.880 \times 43'' \times 0.00000485 = 0.000183$$

$$y + \Delta y = \sin 28°24'43'' = 0.475807 \text{ Answer}$$

The constant 0.00000485 is the value in radians for one second of arc and may be conveniently memorized for use in all such calculations. The number of seconds multiplied by this constant gives the value of $\Delta\theta$. The first three digits of $\cos\theta$ may be obtained from the cosine column, which is usually adjacent to the sine column in the tables of functions, and the extension made on a slide rule. The use of the slide rule will give the required degree of accuracy, since the value of Δy never exceeds three decimal places as long as $\Delta\theta$ is less than one minute. The procedure in obtaining the value of the cosine is similar to that just described and is given by the following approximate equation:

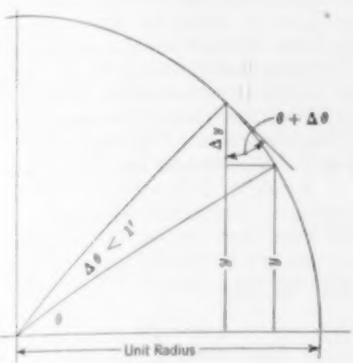


Fig. 1

$$\cos(\theta + \Delta\theta) = \cos\theta - \sin\theta\,\Delta\theta \quad \ldots\ldots(6)$$

Example: Find cos 28°24′43″

$$\cos 28°24' = 0.879649 \text{ (from tables)}$$

$$-0.476 \times 43'' \times 0.00000485 = -0.000099$$

$$\cos 28°24'43'' \qquad 0.879550 \text{ Answer}$$

The method may also be applied to tangents but is not in as convenient a form as for the sine and cosine, and no saving in time is realized over the conventional method of taking the proportional part of the difference of the functions. The approximate equation is

$$\tan(\Delta + \Delta\theta) = \tan\theta + \overline{\sec}^2\,\theta\,\Delta\theta \quad \ldots\ldots(7)$$

To reverse the operation—that is, to find the value of the angle when the function is given—we may write Eq. 5 in the form,

$$\frac{\sin(\theta + \Delta\theta) - \sin\theta}{\cos\theta} = \Delta\theta \quad \ldots\ldots\ldots\ldots(8)$$

and proceed as follows:

Given: $\sin(\theta + \Delta\theta) = 0.475807$

$$\sin\theta = \sin 28°24' = \frac{0.475624}{0.000183} \text{ (from tables)}$$

$$\Delta\theta = \frac{0.000183}{0.880 \times 0.00000485} = 43''$$

$$\theta + \Delta\theta = 28°24'43''$$

Similarly, the value of the angle when the cosine is given may be determined by rearranging Eq. 6.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Need for Agencies to Coordinate Earthquake Studies

To the Editor: The importance of Professor Martel's paper, which appeared in the January issue, lies not only in what he says but also in how he says it. Older engineers who, as John Trautwine puts it, "have long since forgotten the little higher mathematics they once knew," will be cheered by the discovery of a colleague who knows his subject sufficiently well to discuss it simply.

The keynote of the paper is a question, "What are the bottom facts?" and a challenging, rather than cynical answer, "There are none!"

Students know that, in spite of numerous erudite and sometimes tiresome discussions, there has been little actual progress in the art of earthquake-resistant construction during the past twenty years. We cling to the lateral force hypothesis, an admittedly faulty premise, because practical dynamic analysis must start with the time-space characteristics of ground motion, concerning which we know little. Certainly, there is no advantage in perfecting methods for structural analysis of the effects of vibratory motion until reasonable assumptions can be made about that motion. Yet we have striven so valiantly to understand an effect, without considering its cause, that Professor Martel is obliged to admit, for us, that the scientific study of the structural effect of earthquakes has examined everything except the earth that shakes.

Professor Martel reveals that what actually is known about earthquake surface motion is embarrassingly insufficient, annoyingly vague, and often perplexingly contradictory. He exhibits a comprehensive and well-ordered array of material, asks a question, "Are these sufficient?" and challenges himself, and the rest of us, with the only possible answer, "From an engineering standpoint no!" We are saddened by the realization that we have learned so many things that aren't so but, as engineers, we may take comfort in the knowledge that the first of all construction processes is clearing the site. Truly, "The realization of ignorance is the beginning of wisdom."

From this paper, it is evident that we must begin by discarding most of our notions about foundation behavior. The mass of material now constituting our understanding of this all-important phenomenon must be sieved to separate fact from fancy, truth from prejudice, even though this process leaves us but a handful of facts, or possibly none at all. Only upon such a foundation can we hope to erect something sound, tangible, and useful. We should know what we know and be prepared to teach as we learn, and to condemn error wherever we find it.

Such an undertaking is too big for small tactics. It demands strong leadership, coordinated effort, and honesty of purpose. We will make little progress in earthquake-resistant construction until there is established some agency from which engineers can obtain authoritative, accurate, and understandable information, particularly concerning the earth that shakes.

C. J. Derrick, M. Am. Soc. C.E.
Consulting Engineer

Los Angeles, Calif.

Bidding "By Inch of Candle"

DEAR SIR: The original of the accompanying picture, which hangs on my study wall, I call "When Bids Were Bids." I often gaze at it wistfully, especially after discussing with my class the manifold inquisitory tactics that public officials are in duty bound to pursue these days in dealing with contractors who have the temerarious urge to build something. "Life," says the picture to me, "wasn't nearly so hectic when men trusted each other more."

A word of explanation of the unusual scene is in order. It purports to be that of a public letting somewhere in France in the latter half of the seventeenth century. No one can mistake the engineer, who in stentorian voice is reeling off the specifications, from "A to Z." Note his plans on the table—perhaps they are those of a fortress on the Flemish frontier. Observe M. de Maupas, the public official or provincial governor of comfortable girth and sardonic countenance, serenely ensconced at the engineer's right.

BIDDING "BY INCH OF CANDLE"
Drawn for Professor Kirby by Frances Farnham Mitchell, Daughter of Prof. C. S. Farnham, M. Am. Soc. C.E.

Most of the rest are of course prospective bidders, including, let us say, François de Longuepierre, Jacques le Crepu, and Henri Chauvelon—poor men all. One, however, looks like a surety, and unfortunately he also looks like the engineer—let us believe he is not a relative.

The three candles on the table are not for purposes of lighting, for in those days such business was transacted by daylight. Rather they take the place of a stop-watch and an auctioneer's hammer combined. For after M. l'Ingénieur has finished his reading they are to be lit one by one, as François announces to all the world that he is prepared to undertake the excavation for the ridiculously low sum of 30 francs a cubic toise. François' neighbor, Jacques, immediately jumps in with an offer to do it better for 29 francs, and the excitement is on. In the next few hours anything can happen. François may underbid himself or anyone else; perhaps the governor may even do some twitting with this in view. Not infrequently the session proves long and stormy, and punctuated, it may be, by an occasional short and ugly word. But, finally, out flickers the last candle, leaving one of the group the lucky, or unlucky, bidder.

(At this point, it is altogether proper to protect the Society by injecting, *a la manière du cinéma*, the covering statement that while this picture is founded on fact—indeed on printed information furnished centuries ago by Vauban and Belidor—the characters are imaginary, and therefore any real or fancied resemblance to persons, living or dead, is purely coincidental.)

I wish I knew where such a practice originated. It is not unreasonable to imagine that something similar prevailed in Roman days, or that even the Greeks had a word for it, but no one seems to know. The French and English used it widely during the seventeenth century and for long afterward in disposing of public property. The French called it selling by *chandelle estiencte* (extinguished candle); the English, selling by *inch of candle*. There are many references in English literature to the practice. Often a pin was stuck into the candle an inch below the top, and when the pin fell out the deal, be it a sale or a lease, was closed. John Milton, blind governmental secretary, wrote familiarly of the practice in Cromwell's day. A few years later the inimitable diarist, Pepys, then only an ambitious young navy clerk, scribbled down the following, in cipher, under date of November 6, 1660: "To our office, where we met all, for the sale of two ships by inch of candle (the first time that I ever saw any of this kind) where I observed how they all do cry and we have much to do to tell who did cry last. The ships were the Indian, sold for £1,300, and the Half-Moone, sold for £830."

The three candles had sometimes a mystical significance. A theological friend reminds me that they served for occasional excommunications; the sinner had a very definite space of time in which to mend his ways, or take the consequences.

RICHARD SHELTON KIRBY, M. Am. Soc. C.E.
Chairman, Department of Engineering Drawing, School of Engineering, Yale University

New Haven, Conn.

Engineers Can Solve Problem of Distribution

TO THE EDITOR: I am pleased to see the interest CIVIL ENGINEERING has taken in recent months in the subject of present economic and social conditions. I have particular reference to the article by Professor Hodges in the January issue. The general impression I get from the various presentations is that the contribution which the engineer can make towards improving these conditions is in the field of higher education. It has been inferred that it is the academic education given the best doctors and lawyers that enables them to become leaders of society. It is thought that engineers, if properly equipped, could also become leaders and lend their efforts to create a better economic understanding. Doctors and lawyers, by the nature of their professions, come more intimately into contact with society than do engineers, thus having some advantages over the latter. However, the engineer has advantages over either in solving problems of production and distribution. Also, doctors and engineers generally choose their profession with a view to practicing it. To keep up with the technique of their professions both must devote their time and their energies to matters other than political contacts or vote getting.

Thus far in the history of nations the directing of economic and social conditions has been left to those able to get control of the people through force, good will, or intrigue. Like a pendulum, the leadership has swung between the high points of absolute dictatorship on the one hand and of pure democracy on the other. In cases of chaotic dissent the dictator reorganizes the so-called pure democracy; in cases of dictatorial injustices some sort of democratic rule follows. This process of building up and tearing down can be called a disease of human nature. It might be said that governments have their youth, their middle age, their old age, and death. The question is what can we do about it. The same question, in some form, has existed throughout history. The doctors and scientists have solved many human ills. The engineer has solved many economic problems—so many that a hundred people can now live in comfort where one would formerly have starved. In fact the engineer is accused by some demagogs of ruining our economic system by overproduction, which causes people to starve because we cannot distribute our present economic system.

The engineer has mastered the problem of production. If he is to solve the problem of distribution, he must, first of all, become conscious of the above-mentioned facts. I believe that a few of the fundamental principles of prosperity should be a part of the curriculum of the 75% who have never taken an academic educational course. The economic consciousness of our present-day youth should at least be brought up to the level that prevailed when home teachings were the rule and the majority learned economic principles by struggling for a living. Investigation shows that there is no interest in most lower grade educational institutions in instructing the young in economics except to encourage them to imitate others in getting rich. Education at both ends of the curriculum can prepare most people, who are at the heads of our governments, to benefit by the truths which must be applied to bring about continuous prosperity.

However, to elucidate the principles of production and distribution which can maintain a continued prosperity will require a Sir Isaac Newton or a good civil engineer to formulate mathematical principles, or a Christopher Columbus to demonstrate semi-proved facts. If the public consciousness is educated so it can receive, the engineer can write the formula. This state of affairs cannot be brought about by occasional "jabs" at the subject. I believe that a small amount of space in Civil Engineering could profitably be used for general discussion on this subject, enabling those interested to contribute to the cause.

Guy B. Waite, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.

The WPA and Fees for Consulting Architects and Engineers

To the Editor: It may be of general interest to the engineering profession to know of some of the incidental results of the Work Projects Administration in the State of New York that directly affect the profession.

It has been the policy of the State Administrator, Mr. Lester W. Herzog, that this Administration will not permit the operation of projects to give technical assistance to any municipal engineering or architectural staff, as we believe that any such project would displace civil service employees and encroach upon the field of the consulting engineer or architect.

A survey just completed shows that consultants in the up-state area have received 169 commissions, and have prepared plans and specifications for which they have received in fees approximately $1,494,491.

These figures do not take into consideration any of the plans and specifications prepared by the staff of appointive or civil service employees of various municipal units.

Clarence W. Post M. Am. Soc. C.E.
Deputy Administrator and Chief Engineer,
Work Projects Administration of New York State

Albany, N.Y.

Reorganizing Railroads in Bankruptcy

To the Editor: In these days a sound and equitable plan for the reorganization of railroads in bankruptcy should be of general interest. Such a plan must be based upon two principles: (1) a sound physical foundation upon which to build a strong new financial structure, and (2) a capitalization upon which an allocation of present security can be made upon a just and equitable basis.

Any plan that does not conform to these requirements will result in future default of the reorganized corporations—and proof of this fact is evident in the repeated defaults in former railroad reorganizations, which have ignored these fundamental principles.

The present practice of making a drastic financial plan, before establishing a sound physical foundation, is "putting the cart before the horse." A sound transportation system cannot be built up in this manner any more than can a stable structure be built upon shifting sand. One of the weaknesses of the present railroad transportation system is a large surplus mileage and facilities which are unprofitable and a drain upon the profitable portions of the system. Many railroad bankruptcies have been caused by about 20% of useless mileage draining the profits of the remaining 80%. No financial plan of reorganization will be successful unless the "dead wood" is cut out.

This task has not been accomplished by either the managements or the protective committees because of the desire to hold on to the useless mileage, capitalize it, and build up as large a capitalization as possible, regardless of future results. The Interstate Commerce Commission has likewise sidestepped this disagreeable duty in the plans before it. The Commission's examiners in their eagerness to set up a drastic plan have resorted to the practice of finding "that the stock of the old company has no value." If they were as diligent in finding out what portions of the bankrupt system have useless and unprofitable mileage, they would find, in many instances, that the stock, which has been as a whole declared of no value, has distinct value on the profitable parts of the system. The Commission now has the power and authority to abandon useless and unprofitable mileage, and such mileage should not be incorporated into the reorganized system.

Many of the proposed plans of reorganization provide for the elimination of all the stock, both preferred and common, of the old company, and the equity holders are dispossessed of the right to participate in the reorganization.

A bankrupt system may be composed of a number of mortgage sections, each independent and separate entities. Many of these sections include portions of the lines which have been operated profitably during the depression, some of them even earning their fixed charges. On such parts of the system the stock equity has a distinct value and is entitled to participation in the allocation of new securities and the right to be considered in reorganization. There are other mortgage sections where operations have resulted in the failure to earn any or only a small part of their carrying charges. It is proposed to wipe out the old stock on the prosperous portions of the road and then apply it for distribution among the unprofitable portions, the value of which is even less than the equity on the prosperous portions of the lines.

The only fair and equitable basis of allocating new securities in the reorganization of bankrupt railroads is to value each section under separate mortgages on the basis of its earning power. Eliminate all unprofitable portions from the plan, then determine the value of the remainder and allocate securities on the basis of real value. The Commission has ample information to determine such values, and can readily pass upon the matter of abandonment of unprofitable portions of the system. Every mortgage section should be treated as a separate entity, and the value of one section should not be applied to another section. The equity on an unprofitable section may be found of no value, but, if it is found to have a value on the prosperous sections it should not be eliminated and its value transferred to a security on an unprofitable part of the system. It remains to be seen if the Courts will approve the unconstitutional and inequitable plans which have thus far been proposed.

As long as the railroads now in default remain so they constitute a cancer in the railroad industry. Not a single Class I railroad has been reorganized in the past eight years, because the basic principles herein proposed have been ignored. The Interstate Commerce Commission can reorganize these railroads within a reasonable time, if it will exercise its power to do so. If it fails in its duty there is only one alternative and that is government ownership, with its attendant evils.

L. C. Fritch, M. Am. Soc. C.E.

Pasadena, Calif.

The Wailuku River Bridge

To the Editor: It is to be regretted that the appearance of the very beautiful bridge over the Wailuku River in Hawaii, as shown in Mr. Ciufi's article in the February issue of Civil Engineering, is marred by the failure of the designer to allow for the optical illusion, caused by the combination of the curve of the arch with the straight floor line.

It is necessary to test the line of the floor with a straightedge to convince the eye that it has not an unpleasant sag. A very considerable camber would have been necessary to overcome this defect, but it would have been well worth while.

J. R. Worcester, Hon. M. Am. Soc. C.E.

Boston, Mass.

Problems in Soil Consolidation

TO THE EDITOR: In connection with Professor Kimball's article on "Settlement Studies of Huey P. Long Bridge," in the March issue, a possible explanation of the pier movements has occurred to me, based on the idea that engineering idealizations of materials and conditions must now and then be critically examined, instead of being taken for granted as they too often are.

In the theory of soil consolidation, the idealized material is a network or structure of incompressible solid particles, having the pores filled with an incompressible fluid. This automatically leads to the conclusion that the mass as a whole is incompressible, unless there is a change in the amount of fluid contained in the voids.

Like other engineering idealizations, this one is extremely useful, but it is not strictly true. The solid particles are slightly compressible; the fluid, even if entirely a liquid, is slightly compressible; and if the fluid contains some gas, as well as liquid, it is considerably more compressible. Therefore, in actuality the mass can be compressed to some extent without change of fluid content.

My hypothesis is that, due to the existence of a great depth of saturated soil below the bridge piers, these secondary effects, which are usually negligible, are so multiplied as to produce measurable movement of the piers. In particular, the presence in the pore water of a relatively small quantity of air or of gaseous products of organic decomposition would make the mass as a whole sufficiently compressible to account for the observed movements, as an effect entirely separate from, and superimposed upon, the settlements due to straightforward consolidation.

If this idea is sound, it follows that the readjustment of secondary effects will be influenced by the permeability of the soil. As the additional water load is imposed by a rise of river level, secondary compression will produce a lowering of the piers. However, there will also be a tendency for the newly imposed water stresses to become equalized within the voids of the soil, with a resultant raising of the piers due to elastic rebound of the soil structure. The end-point, if the water stays high long enough, will be a position slightly higher than the original, due to slightly greater displacement of the piers. The two tendencies oppose each other, and the relative predominance of one or the other will depend on the rapidity of readjustment of pore-water stress, which is in turn a function of permeability. Therefore, with a highly pervious underground, a rise of water level would tend to produce a raising of the piers. With a relatively impervious underground, the initial lowering would predominate.

This hypothesis may seem to complicate the situation, rather than to simplify it, but at present I cannot visualize the phenomenon as anything less than a rather complicated interaction of two opposing influences.

Although the problem is not one of great practical moment, it seems worth following through to a complete explanation. It is hoped that Professor Kimball will find the opportunity to collect similar data from other sources.

GLENNON GILBOY, Assoc. M. Am. Soc. C.E.
Consulting Engineer

Lincoln, Mass.

Eccentric and Oblique Loading of Concrete Columns

DEAR SIR: In connection with the interesting article by Paul Andersen, published in the January issue of CIVIL ENGINEERING under the title, "A Graphical Method of Analyzing Eccentrically Loaded Concrete Sections," it is perhaps not superfluous to give the following supplementary information.

The problem of eccentric and oblique loading of reinforced concrete columns has been treated in great generality by Prof. A. Roussopoulos in the *Technical Annals*, Athens, Greece, May 1 and 15, 1933. This extensive paper, entitled "General Solution of Eccentric Normal Loading of Reinforced Concrete Sections," is written in Greek and contains 12 charts relating to rectangular cross sections. These charts facilitate greatly the application of theory to practical problems.

A German translation of the part of this paper pertaining to rectangular cross sections appeared in *Beton u. Eisen* for March 5, 1939, under the title, "Die allgemeine Lösung des Problems der exzentrisch beanspruchten Eisenbetonguerschnitte (Schiefe Biegung mit Axialkraft)."

Independently of the above paper, L. T. Evans, M. Am. Soc. C.E., has solved the same problem in a thorough and systematic manner, in a book to be published soon. In this very complete treatise on the subject, there are 98 full-page charts applicable to all shapes of cross sections and all loading conditions. Being dimensionless, they can be used everywhere, whether the English or the metric system of units is in use.

A. FLORIS

Los Angeles, Calif.

Closure of Discussion on Engineering Enrolments

TO THE EDITOR: I appreciate the careful reading and thought displayed by Mr. Osgood's discussion (CIVIL ENGINEERING for December) of my paper, "Professional Standards vs. Mass Production in Engineering Schools," in the September issue. The subject is an exceedingly difficult one to consider without prejudice, although such was the writer's intention. Mr. Osgood apparently perceived this and discussed the article in like fashion, for which I am deeply indebted.

Mr. Osgood has correctly interpreted my differentiation between the "fundamentals" and the "technics" of engineering. I hasten to concur with him that the students should have the fundamentals prior to the professional applications, and teaching staffs should be commended for placing the emphasis on the "routine drill of fundamentals" in the four-year curriculum. As suggested by Mr. Osgood, a three- or four-year science curriculum meeting the approval of the engineering profession, followed by two years of intensive professional training in an engineering school, would certainly fulfil the requirements of the "liberal" as well as the "professional" advocates, particularly since the additional two years could be omitted by those not interested in a professional training. Cooperative arrangements with industry or private practitioners during the final two years would aid in properly placing graduates interested in the technical fields. With adequate advance planning, such a policy would not require any unusually difficult changes in the present curriculum, but would have to be applied to all institutions at essentially the same time in order to become fully effective.

I would like to take this opportunity to answer the many written and verbal comments personally received concerning the article, as I believe them to be of general interest. I am sorry that these individuals did not utilize the opportunity for discussion offered by the Society. In fact, I feel that such an obligation should not be dismissed lightly. With the exception of the commendatory letters, these comments can be divided into two groups: (1) Those inquiring about the status of the particular school with which the individual happened to be connected, and (2) those taking exception to my implied objection to the apparent academic policy of recommending engineering as a general training.

To the first I would like to suggest that they might more properly be concerned over the rather widespread lack of ability or desire, on the part of academic groups, to voluntarily attain and maintain uniform teaching standards of professional quality. The mere fact that teaching conditions in an institution are better than the average does not relieve the institution or its individuals of the broader professional responsibilities. It is equally true that an institution below average should not be criticized, since to my knowledge no specific recommendations for enrolment restriction or staff size have ever been made. Hence the liberal attitude in the accrediting of institutions in so far as this is concerned.

To the second group I wish only to say that I readily (and emphatically) admit that an engineering education is a good general training. Any work which develops an ability to think critically may be classified in the same manner. I seriously question, however, if an engineering education should be considered a vocational panacea.

GEORGE C. ERNST, Assoc. M. Am. Soc. C.E.
Assistant Professor of Civil Engineering,
University of Maryland

College Park, Md.

Spring Meeting in Kansas City, Mo.

Hotel Continental to Be Headquarters, April 17–19, 1940

Program of Meetings, Entertainment, and Trips

Opening Session and General Meeting

WEDNESDAY—April 17, 1940—Morning

9:00 **Registration**

Hotel Continental is the headquarters for all sessions of the Spring Meeting.

10:00 **Spring Meeting called to order by**

R. N. BERGENDOFF, *President, Kansas City Section, Am. Soc. C.E.; Consulting Engineer*, Kansas City, Mo.

Addresses of Welcome

Response

JOHN P. HOGAN, *President, American Society of Civil Engineers*, New York, N.Y.

SYMPOSIUM ON THE RESOURCES OF THE MID-CONTINENT AREA

11:00 **Introductory Paper**

DR. H. A. BUEHLER, *Past-President, American Institute of Mining and Metallurgical Engineers; State Geologist*, Rolla, Mo.

WEDNESDAY—April 17, 1940—Afternoon

JAMES L. FEREBEE, *Vice-President, Am. Soc. C.E., Presiding*

SYMPOSIUM ON THE RESOURCES OF THE MID-CONTINENT AREA (Continued)

2:00 **Agricultural Resources**

W. A. COCHEL, *Editor, The Weekly Kansas City Star*, Kansas City, Mo.

2:30 **Water Resources**

GEORGE S. KNAPP, *M. Am. Soc. C.E., Chief Engineer, Division of Water Resources, State Board of Agriculture*, Topeka, Kans.

3:00 **Industrial Development**

P. E. TAYLOR, *General Industrial Agent, Atchison, Topeka and Santa Fe Railway*, Topeka, Kans.

3:30 **Mineral Resources Including Gas and Oil**

DR. RAYMOND C. MOORE, *State Geologist and Director, State Geological Survey of Kansas*, Lawrence, Kans.

4:00 **Railroads**

C. E. JOHNSTON, *M. Am. Soc. C.E., Chairman, Western Association of Railway Executives*, Chicago, Ill.

4:30 **Discussion**

DOWNTOWN SKYLINE OF KANSAS CITY
Union Station in the Foreground

AIR VIEW OF DOWNTOWN KANSAS CITY
Municipal Auditorium in the Foreground

Dinner, Entertainment, and Dance at Hotel Continental

WEDNESDAY—April 17, 1940—Evening

7:00 p.m.

Presiding: R. N. BERGENDOFF, *President, Kansas City Section, Am. Soc. C.E.; Consulting Engineer*, Kansas City, Mo.

Speaker: HON. MERRILL E. OTIS, *Judge, U.S. District Court, Western District of Missouri*, Kansas City, Mo.

Tickets for the dinner and evening's entertainment are $3.00 each. Students will be admitted free for dancing upon presentation of student cards.

Sessions of Technical Divisions

THURSDAY—April 18, 1940—Morning

CONSTRUCTION DIVISION

JOHN W. COWPER, *Chairman, Executive Committee, Presiding*

9:00 **Horse and Buggy Days of Bridge Building**

H. S. TULLOCK, *M. Am. Soc. C.E., President, The Missouri Valley Bridge and Iron Company*, Leavenworth, Kans.

10:00 **Gasoline Pipe Lines—Design and Construction**

A. H. RINEY, *M. Am. Soc. C.E., Vice-President, Phillips Petroleum Company*, Bartlesville, Okla., and STANLEY LEARNED, *Chief Engineer, Phillips Petroleum Company*, Bartlesville, Okla.

11:00 **The Design and Construction of the Kansas City Municipal Auditorium**

S. J. CALLAHAN, *Assoc. M. Am. Soc. C.E., Supervising Engineer, Public Works Department*, Kansas City, Mo.

Discussion

HIGHWAY DIVISION

WILLIAM N. CAREY, *Chairman, Executive Committee, Presiding*

9:00 **Developments in Missouri to Cover the Planning Survey and Traffic Needs in Metropolitan Areas**

C. W. BROWN, *M. Am. Soc. C.E., Chief Engineer, State Highway Department*, Jefferson City, Mo.

9:30 **The Trends of Highway Construction to Meet Traffic Growth**

CHARLES D. VAIL, *M. Am. Soc. C.E., State Highway Engineer, State Highway Department*, Denver, Colo.

10:00 **Low-Cost Roads to Meet Needs of Economy in Kansas**

R. B. WILLS, *M. Am. Soc. C.E., State Highway Engineer, State Highway Commission*, Topeka, Kans.

10:30 **Soil Studies Applied to Highway Construction and Maintenance**

F. V. REAGEL, *Engineer of Materials, State Highway Department*, Jefferson City, Mo.

11:00 **Discussion**

SANITARY ENGINEERING DIVISION

EARLE L. WATERMAN, *Chairman, Executive Committee, Presiding*

9:00 **The Development of a Water Supply for Wichita, Kans.**

R. E. LAWRENCE, *Assoc. M. Am. Soc. C.E., Associate Engineer, Black and Veatch*, Kansas City, Mo.

Discussion opened by

P. L. BROCKWAY, *M. Am. Soc. C.E., City Engineer*, Wichita, Kans.

STANLEY LOHMAN, *Geologist in Charge of Ground Water Investigations in Kansas, U.S. Geological Survey*, Lawrence, Kans.

10:00 **Developments and Future Problems in Water Supply and Sanitary Sewage in the Mid-Continent Area**

EARNEST BOYCE, *M. Am. Soc. C.E., Engineer and Director, Division of Sanitation, State Board of Health; Professor, Sanitary Engineering, University of Kansas*, Lawrence, Kans

Discussion opened by

W. W. HORNER, *M. Am. Soc. C.E., Consulting Engineer; Professor, Municipal and Sanitary Engineering, Department of Civil Engineering, Washington University*, St. Louis, Mo.

11:00 **Development of Sewage Treatment in the Sanitary District of Chicago**

NORVAL E. ANDERSON, *M. Am. Soc. C.E., Assistant Engineer of Treatment Plant Design*, and L. C. WHITTEMORE, *M. Am. Soc. C.E., Engineer of Design, The Sanitary District of Chicago*, Chicago, Ill.

Discussion

POWER DIVISION

WILLIAM P. CREAGER, *Chairman, Executive Committee, Presiding*

9:00 **Relative Availability, Cost, and Means of Production of Coal for the Generation of Power**

C. Y. THOMAS, *Chief Engineer, Pittsburg and Midway Coal Mining Company*, Pittsburg, Kans.

9:30 **Discussion opened by**

G. F. KLEIN, *Consulting Engineer, Mackie Clemens Fuel Company*, Kansas City, Mo.

E. L. MCDONALD, *Efficiency Engineer, Kansas City Power and Light Company*, Kansas City, Mo.

10:00 **Relative Availability and Cost of Oil and Gas for the Generation of Power**

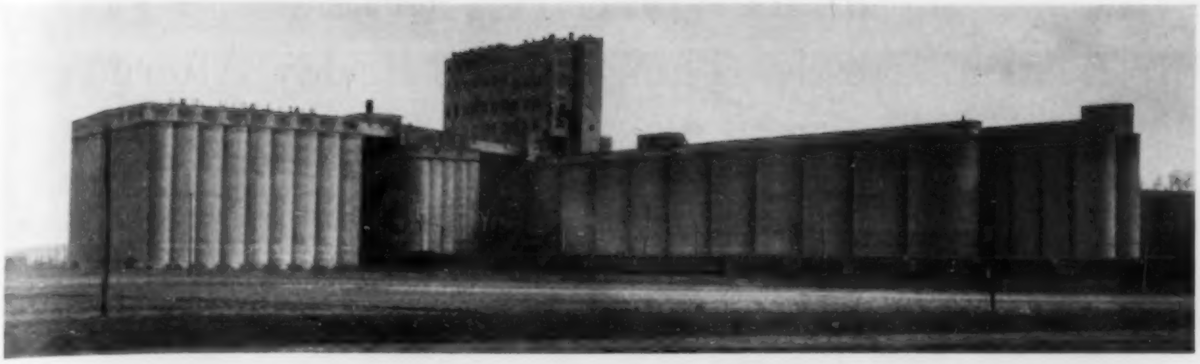
E. H. POE, *Secretary, Natural Gas Division, American Gas Association*, New York, N.Y.

10:30 **Discussion**

11:00 **General discussion of power problems**

KANSAS CITY STOCKYARDS, SCENE OF A THURSDAY INSPECTION TRIP

SHEFFIELD STEEL MILL, TO BE VISITED FRIDAY AFTERNOON



ONE OF KANSAS CITY'S LARGE GRAIN STORAGE ELEVATORS—TO BE VISITED ON THURSDAY AFTERNOON

Sessions of Technical Divisions

FRIDAY—April 19, 1940—Morning

JOINT SESSION—CITY PLANNING AND ENGINEERING ECONOMICS DIVISION

HARLAND BARTHOLOMEW, *Chairman, Executive Committee, City Planning Division, Presiding*

9:00 **Economic Considerations Involved in the Planning of Cities**
Speaker to be announced.

10:00 **Comparative Costs to the City for Public Services in New Versus Old Residential Areas**
F. DODD MCHUGH, *Director of Research, Department of City Planning, City Planning Commission,* New York, N.Y.

11:00 **Discussion**

HYDRAULICS DIVISION

FRED C. SCOBEY, *Chairman, Executive Committee, Presiding*

9:00 **A Civil Engineer's Conception of Turbulence and Its Use**
SAMUEL SHULITS, *Assoc. M. Am. Soc. C.E., Associate Hydraulic Engineer, Flood Control Division, U.S. Engineer Office, Louisville, Ky.*

9:30 **Discussion opened by**
E. W. LANE, *M. Am. Soc. C.E., Professor, Hydraulic Engineering, Hydraulic Laboratory, University of Iowa,* Iowa City, Iowa.

A. A. KALINSKE, *Assistant Professor, Iowa Institute of Hydraulic Research,* Iowa City, Iowa.

10:00 **The Application of Hydraulics to the Determination of Runoff from Rainfall, Without the Use of Runoff Coefficients**
W. W. HORNER, *M. Am. Soc. C.E., Consulting Engineer; Professor, Municipal and Sanitary Engineering, Department of Civil Engineering, Washington University,* St. Louis, Mo.

10:30 **Discussion**

SURVEYING AND MAPPING DIVISION

WILLIAM BOWIE, *Chairman, Executive Committee, Presiding*

9:00 **Reconnaissance Surveys**
L. B. ROBERTS, *M. Am. Soc. C.E., Assistant Chief Engineer, New York World's Fair Corporation,* Flushing, N.Y.

10:00 **Mapping Program for the United States**
WILLIAM BOWIE, *M. Am. Soc. C.E., Hydrographic and Geodetic Engineer, U.S. Coast and Geodetic Survey (Retired),* Washington, D.C.

11:00 **Discussion**

STRUCTURAL DIVISION

CHARLES F. GOODRICH, *Chairman, Executive Committee, Presiding*

SYMPOSIUM ON PREPARATION AND RECONDITIONING STRUCTURAL STEEL SURFACES FOR PAINTING

9:00 **Introductory Remarks**
E. R. NEEDLES, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y.

9:15 **Sand Blast Cleaning of Structural Steel**
A. B. DAVIS, *Assoc. M. Am. Soc. C.E., Manager, Memphis Plant, Virginia Bridge Company,* Memphis, Tenn.

9:35 **Flame Cleaning of Structural Steel**
FREDERICK H. DILL, *Assoc. M. Am. Soc. C.E., with American Bridge Company,* Ambridge, Pa.

9:55 **Flame Cleaning Equipment and Gases**
F. C. HUTCHISON, *Manager, Process Service, Southwestern Division, The Linde Air Products Co.,* Kansas City, Mo.

10:15 **Reconditioning Surfaces Preparatory to Painting**
R. G. CONE, *M. Am. Soc. C.E., Engineer, Golden Gate Bridge and Highway District,* San Francisco, Calif.

10:35 **Shop Painting as Protection for Structural Steel**
DR. C. F. RASSWEILER, *Director, Philadelphia Laboratory, E. I. du Pont de Nemours and Co., Inc.,* Philadelphia, Pa.

10:55 **Discussion opened by**
JONATHAN JONES, *M. Am. Soc. C.E., Chief Engineer, Fabricated Steel Construction, Bethlehem Steel Company,* Bethlehem, Pa.

J. G. MAGRATH, *Applied Engineering Department, Air Reduction Sales Company,* New York, N.Y.

WATERWAYS DIVISION

WILLIAM G. ATWOOD, *Chairman, Executive Committee, Presiding*

9:00 **Development and Maintenance of a Navigable Channel in the Missouri River**
D. R. NEFF, *Senior Engineer, U.S. Engineers,* Kansas City, Mo.

Discussion opened by
GEORGE J. MILLER, *Executive Secretary, Missouri River Navigation Association,* Kansas City, Mo.

10:00 **The Effect of Recent Cutoffs and Channel Improvement Work on Navigation on the Mississippi River**
G. R. CLEMENS, *M. Am. Soc. C.E., Senior Engineeer Mississippi River Commission,* Vicksburg, Miss.

Discussion opened by
G. C. TAYLOR, *General Superintendent, Mississippi Valley Barge Line Co.,* St. Louis, Mo.

11:00 **Some Modern Developments in Towboats and Barges and Their Use on Inland Waterways**
ALEX W. DANN, *Assoc. M. Am. Soc. C.E., Executive, Vice-President Dravo Corporation,* Pittsburgh. Pa.

Inspection Trips for Thursday and Friday Afternoons

THURSDAY—April 18, 1940—Afternoon

1:30 Inspection Trips

Arrangements have been made for a number of inspection trips all starting from the Hotel Continental at 1:30 p.m.:

1. **Municipal Auditorium—Six-Million-Dollar Project**
2. **Residential District, passing en route Nelson Gallery of Art and the University of Kansas City**
3. **Packing House District, passing en route the new Kansas City, Kans., Food Terminal**
4. **Flour Mills and Elevators**

No charge for these trips.

1—Municipal Auditorium

A modern convention hall of 32 units affording a range of seating capacities from 25 to 14,000. Completed in 1936 at a cost of approximately $6,500,000. Located at 13th and Wyandotte within three blocks of 3,000 hotel rooms. Includes huge arena seating 14,000; a fully equipped theater and music hall; 120,000 sq ft of exhibit space; and 25 additional units seating from 25 to 650.

2—Residential District

The Country Club District in Kansas City comprises 4,000 contiguous acres of residential property. It is a development which began in a year of money panic, 1907. Now it is recognized as one of the foremost residential developments in the country, and is studied as a model by the subdividers and city planners throughout the country. Its development has been based on progressive ideas of land use, of restrictions, of expensive beautification, of cultivation and scrupulous maintenance of natural beauty, of scientific city planning in every phase of building and development, of group planning of complete shopping centers and store buildings.

3—Packing House District

In years of normal supply and demand Kansas City packing plants turn out products with a finished value of more than $200,000,000. Volume of business is second only to that of Chicago with representatives of each of the "big-four" packing plants, Armour, Cudahy, Swift, and Wilson. In addition to meat, they produce bone buttons, shoe leather, soap, animal extracts, and other ingredients for medicinal purposes, and an infinite variety of other by-products not generally regarded as having their origin in a packing house. Their laboratories are constantly at work to produce a greater utilization of by-products.

4—Flour Mills and Elevators

Greater Kansas City, situated at the eastern edge of the country's hard wheat producing area, ranks second in the United States for flour milling capacity. The combined production of the flour mills is 30,000 bbl per day, besides many tons of mill feeds. The flour mills include three plants having a production each of around 7,000 bbl per day. Besides the flour mills there are plants for producing mixed feed for livestock, one having a rated production of 500 tons per day. The Corn Products Company has one of the largest plants in the country for manufacturing starch, syrup, oil, and other products.

Kansas City is the largest hard winter wheat market in the world. This fact has led to the construction of very great grain storage facilities. The combined storage capacity of Kansas City elevators is around 60,000,000 bu. Elevator "A" owned by the Santa Fe Railroad with a capacity of 10,500,000 bu, is the largest inland grain elevator in the world.

The trip to mills and elevators will cover a mill in which the reinforced concrete was constructed with sliding forms. A description of this operation will be given on the trip.

FRIDAY—April 19, 1940—Afternoon

1:30 Inspection Trips

Arrangements have been made for a number of inspection trips, all starting from the Hotel Continental at 1:30 p.m.:

- 5*a*. **Kansas City, Mo., Airport**
- 5*b*. **Water Works**
- 6. **Steel Mill**
- 7. **Power Plants in Industrial District**
- 8. **Cement Mill, Wire Rope Plant, and Oil Refinery**

No charge for these trips.

5*a*—Kansas City, Mo., Airport

The Kansas City, Mo., Municipal Airport has been built in a big U-bend of the Missouri River and is located just across the river from Kansas City. It is $1^1/_2$ miles from the center of the downtown business district. The trip by bus is made in five minutes. Its runways and taxiways are of concrete.

5*b*—Kansas City, Mo., Water Works

The source of water supply of Kansas City, Mo., is known as the North Kansas City Water Purification Works, which was constructed and placed in operation in 1928. Water is pumped from an intake on the river into four clarifying basins, and flows from there by gravity into settling basins, thence on to filters and finally into a clear well under the filters. The water is pumped from the clear well through a concrete-lined tunnel to a point on the south bank of the Missouri River, where it is divided, part going to the Turkey Creek high-pressure station, the balance to the East Bottoms high-pressure station.

6—Steel Mill

The Sheffield Steel Corporation, one of Missouri's major industries, manufactures more different kinds of steel and steel products than any other single mill in the country. Sheffield's Kansas City plant covers more than 100 acres.

7—Power Plants—Kansas City, Mo.

Northeast Station is the largest plant of the Kansas City Power and Light Company, subsidiary of the United Light and Power Company. It is a modern plant of 170,000-kw capacity, containing five turbo-generators operating at 265-lb steam pressure and two operating at 1,350 lb. Both coal and gas are used for fuel.

Power and Water Plants—Kansas City, Kans.

The water and light plants of Kansas City, Kans., are municipally owned and are located at Quindaro on the Missouri River.

The water plant consists of 25-mgd filtration plant, low- and high-lift pumping stations. A new 25-mgd capacity high-lift pump, driven by a 2,000-hp motor through hydraulic transmission, is now being erected in a new high-lift pumping station. The two power plants have combined installed capacity of 69,000 kw. The new plant has 40,000-kw installed capacity, and is designed for 100,000-kw ultimate capacity.

8—Cement Mill, Wire Rope Plant, and Oil Refinery

The Missouri Portland Cement Company plant is near Independence, Mo., about 14 miles east of downtown Kansas City. It manufactures cement by the "dry" process, and has an annual capacity of one and one-quarter million barrels. The plant is located in the bluff along the Missouri River and is unique in that its raw materials are secured from the bluff by mining operations. The plant has two rotary kilns, 165 ft long, with a capacity of about 1,750 bbl per day per kiln.

On the trip to the cement mill, opportunity will be given to view the large Standard Oil Refinery at Sugar Creek and the plant of the Union Wire Rope Company in the Blue River bottoms.

Dinner and Social Evening at Hotel Continental

THURSDAY—April 18, 1940—Evening

7:00 p.m.

A variety of musical, speaking, and other entertainment has been arranged that promises to make this function one of the highlights of the meeting. Tickets are $2.00 each.

THE WILLIAM ROCKHILL NELSON GALLERY OF ART AND MARY ATKINS MUSEUM

Entertainment for the Ladies

WEDNESDAY—April 17, 1940

12:30 **Ladies' Luncheon at Hotel Continental, followed by inspection of Nelson Art Gallery**

Following the luncheon, the ladies will go on a trip to the Nelson Gallery of Art, starting about 2:00 p.m.

Tickets for the luncheon are $1.25 each.

No charge for the trip.

THURSDAY—April 18, 1940

12:30 **Ladies' Luncheon and Bridge Party at Mission Hills Country Club, followed by trip through residential and garden districts**

Following the luncheon and bridge, the ladies will go on a trip through the residential and garden districts, starting from the Mission Hills Country Club about 3:45 p.m.

Kansas City is noted for its beautiful residential districts and its parks and gardens. Some idea of its charm and beauty may be gained from the illustrations shown on this page.

Tickets for the luncheon and afternoon's entertainment are $1.50 each.

FRIDAY—April 19, 1940

1:30 **Ladies' Tour to Points of Interest in Kansas City**

Following a trip to points of interest to ladies the party will visit the University of Kansas City, where tea will be served about 4:00 p.m. There will be no charge for tickets.

VIEW OF PENN VALLEY PARK OVERLOOKING SKYLINE OF DOWNTOWN KANSAS CITY

RESIDENTIAL GARDEN, MISSION HILLS COUNTRY CLUB DISTRICT

Program of Student Chapter Conference

Wednesday Afternoon and Thursday Morning

WEDNESDAY—April 17, 1940—Morning

9:00 **Registration with all other engineers attending the Spring Meeting**

10:00 **Assembly at Opening Session**

WEDNESDAY—April 17, 1940—Afternoon

JACK P. FULLER, *President, Kansas State College Student Chapter, Am. Soc. C.E., Presiding*

2:00 **Session of Student Chapters called to order**

Welcome

LEONARD I. SHROETER, *President, University of Kansas Student Chapter, Am. Soc. C.E.*

2:15 **The Graduate Engineer's Immediate Future**

E. R. NEEDLES, *M. Am. Soc. C.E., Consulting Engineer,* New York, N. Y.

2:35 **Discussion**

3:00 **The Construction of the Multiple-Arch Dam at Pensacola, Oklahoma**

VICTOR H. COCHRANE, *M. Am. Soc. C.E., Consulting Engineer,* Tulsa, Okla

THURSDAY—April 18, 1940—Morning

ROBERT N. LORANCE, *President, Missouri School of Mines Student Chapter, Am. Soc. C.E., Presiding*

9:00 **Assembly**

9:15 **Ethics of the Engineer**

DANIEL W. MEAD, *Past-President and Hon. M. Am. Soc. C.E., Professor Emeritus, Hydraulic and Sanitary Engineering, University of Wisconsin; Consulting Engineer,* Madison, Wis.

10:00 **Discussion**

10:30 **Student Chapter Conference**

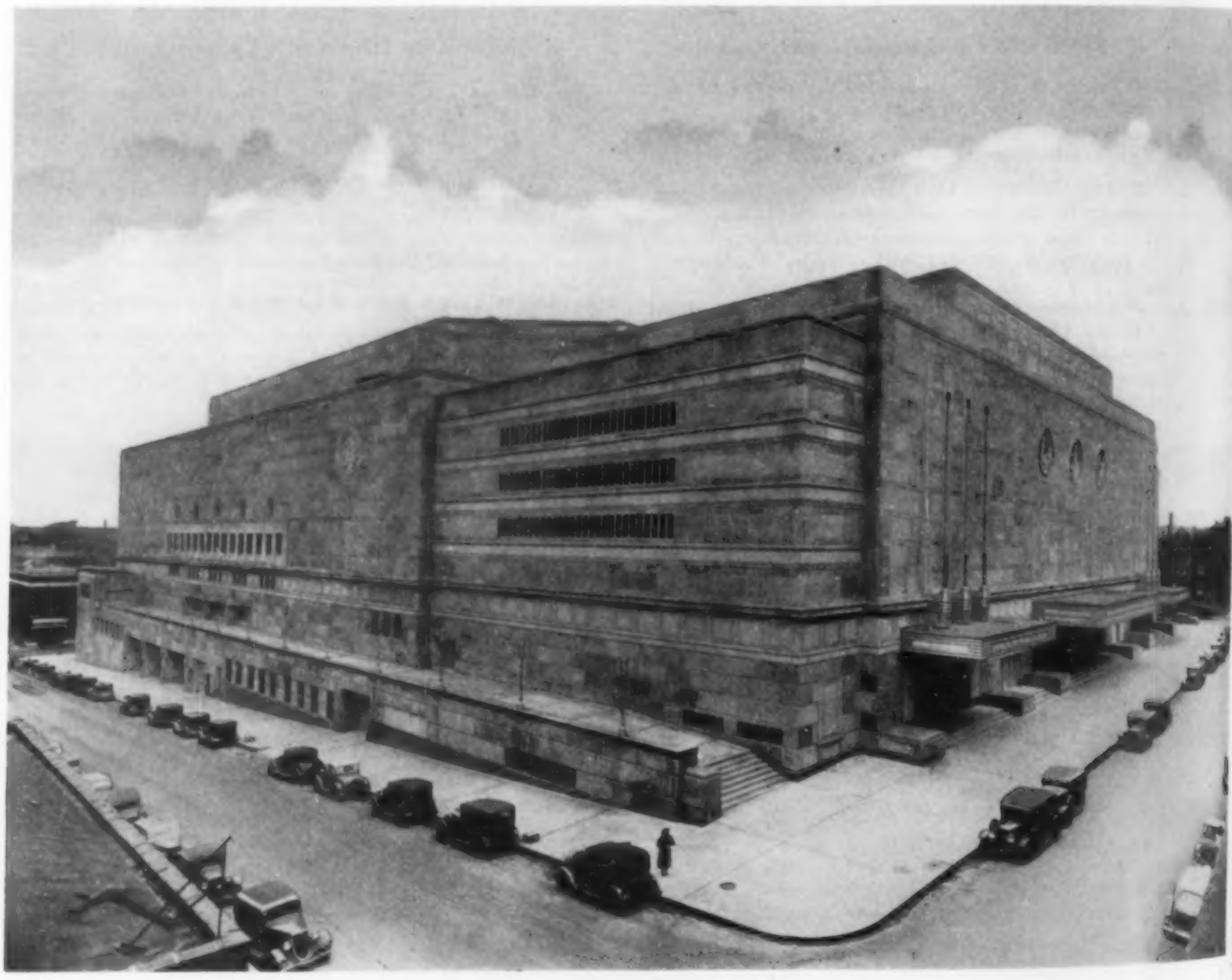
WALTER E. JESSUP, *M. Am. Soc. C.E., Field Secretary, Am. Soc. C.E.,* New York, N.Y.

11:00 **Discussion on the formulation of a Mid-West Conference of Student Chapters.**

12:15 **Luncheon for Student Chapter Members and Representatives**

FREDERICK W. EYSSELL, *Vice-President, University of Missouri Student Chapter, Am. Soc. C.E., Presiding*

Tickets for the Luncheon are 85 cents each.



KANSAS CITY'S $6^1/_2$ MILLION DOLLAR AUDITORIUM, COMPLETED IN 1930

Hotel Accommodations and Announcements

In order to be certain of accommodations, members are urged to make definite arrangements for rooms at least a week in advance of the Spring Meeting, paying for the rooms in advance for at least part of the period for which they expect to be in Kansas City.

The Hotel Continental is the meeting headquarters and, it is expected, will be able to care for all who attend.

Hotel Rates

Hotel	Single Rooms		Double Rooms	
	With Bath	Without Bath	With Bath	Without Bath
Continental	$2.50 up	......	$3.50 up	......
Muehlebach	3.00 up	......	4.50 up	......
President	2.50 up	......	3.50 up	......
Phillips	2.50 up	......	4.00 up	......
Stats	2.50 up	......	3.00 up	......
Robert E. Lee	2.00 up	......	3.00 up	......
Dixon	2.00 up	$1.50 up	3.00 up	$2.00 up

All who attend the Spring Meeting are requested to register immediately upon arrival at headquarters. Special badges and tickets will be obtained at the time of registration.

Local Sections Conference, Tuesday, April 16, 1940

A conference of representatives of Local Sections will meet at 9:30 a.m. on Tuesday, April 16, 1940, at the Hotel Continental. The program will schedule topics of professional rather than technical interest, in which all representatives are expected to participate. All members of the Society are welcome to attend.

Order All Tickets in Advance

Members who order tickets in advance not only will be saved delay by having tickets and badges awaiting them on arrival at headquarters, but they will assist the committee greatly by giving advance information to guide it in concluding arrangements.

See page 30 of Advertising Section for Ticket Order Blank.

Information

A registration desk will be provided in the headquarters hotel to assist visiting members in securing desired information about the city. At the registration desk a card file of those in attendance will be maintained, with information as to Kansas City addresses.

Entertainment for the Ladies

Attention is directed to the entertainment provided for the ladies. It is expected that they will participate with the members in any other features of the program in which they are interested.

Student Luncheon and Conference
Wednesday and Thursday, April 17 and 18, 1940

Members of Student Chapters are invited to participate in all events of the Spring Meeting. Particular attention is called to the Student Conference on Wednesday and Thursday, the luncheon on Thursday, and the special price for students for the Wednesday evening entertainment.

Local Section Officers

R. N. Bergendoff, *President*
F. M. Cortelyou, *First Vice-President*
Wm. M. Spann, *Second Vice-President*
W. G. Fowler, *Secretary-Treasurer*

Executive Committee

A. C. Everham, *Chairman*
A. B. Taylor, *Vice-Chairman*
F. M. Cortelyou

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E. B. Black, *Chairman*
E. E. Howard
Wm. M. Spann

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W. R. Fithian, Ray McFarland
Gordon Hamilton, R. D. McKim
R. B. Houston, R. R. Rising
A. H. Jewell, H. W. Smith
C. D. Whitmire

Reception Committee

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N. T. Veatch, Jr., *Vice-Chairman*
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N. L. Bailiff, E. E. Howard
E. A. Blanpied, H. F. Juengst
W. H. Bosier, K. H. Larkin
T. J. Cambern, J. V. McKinney
H. H. Carrothers, C. L. Metzler
A. T. Cushing, Everett W. Murray
J. P. Edstrand, R. L. Rupley
E. L. Filby, A. F. Schramm
C. S. Foreman, Clifford Shoemaker
Barclay Greene, C. R. Van Orman
H. L. Handley, R. W. Waddell

Ladies Entertainment Committee

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Mrs. Ashley B. Taylor, *Vice-Chairman*
Mrs. R. N. Bergendoff, *Vice-Chairman*
Mrs. Sam J. Callahan, *Secretary*
Mrs. O. W. J. Anschuetz, Mrs. Charles A. Haskins
Mrs. Ned Ashton, Mrs. Fred R. Hoover
Mrs. E. W. Bacharach, Mrs. Jos. W. Ivy
Mrs. Alfred E. Barnes, Mrs. Clark Jacoby
Mrs. Cary Barney, Mrs. G. G. McCaustland
Mrs. E. B. Black, Mrs. R. E. McDonnell
Mrs. J. Fred Brown, Mrs. Ansel N. Mitchell
Mrs. E. Kemper Carter, Mrs. Arthur L. Mullergren
Mrs. Frank M. Cortelyou, Mrs. Robert S. Patterson
Mrs. David M. Dodds, Mrs. Robert L. Rupley
Mrs. Arthur C. Everham, Mrs. Wm. M. Spann
Mrs. E. L. Filby, Mrs. Thos. J. Strickler
Mrs. Warren G. Fowler, Mrs. N. T. Veatch, Jr.
Mrs. Herman H. Fox, Mrs. E. P. Weatherly
Mrs. Barclay Greene, Mrs. Edmund Wilkes, Jr.
Mrs. J. Q. A. Greene, Mrs. Robert P. Woods
Mrs. C. S. Harper, Mrs. O. A. Zimmerman

The wives of all members of the Local Section will act as Assistant Hostesses.

The program as a whole has been prepared under the direction of the Spring Meeting Committee, composed of James L. Ferebee, *Vice-President, Am. Soc. C.E., Chairman;* and Louis E. Ayres, W. W. DeBerard, and Robert B. Brooks, *Directors, Am. Soc. C. E.*

Please call on the Local Committee on Arrangements or on the Secretary's office for any service desired.

SOCIETY AFFAIRS

Official and Semi-Official

Freeman Scholarship Offered This Year for American Study

ANNOUNCEMENT is made by the Society that the Freeman Traveling Scholarship in hydraulics, awarded in the past for work abroad only, is to be given this year for study in the laboratories of the United States. Applications for the award will be received up to June 15, and the selection will be made by the Committee on the Freeman Fund on or before July 1.

Applicants for the scholarship must be American citizens between 24 and 35 years of age. They must have graduated from a technical school of recognized standing, and should have the professional status of a junior teacher. Membership in the Society is considered advantageous. In addition, applicants should be well grounded in mathematics and the mathematical treatment of hydraulic problems. They should preferably have had experience in hydraulic design and construction. Further details as to qualification and method for making application can be secured from Society Headquarters on request.

The committee, pointing out that there are a number of outstanding hydraulic laboratories in this country that a student may profitably visit, states that the recipient will be permitted to select his own itinerary, subject only to committee approval.

The Freeman Scholarships were made possible through the generosity of the late John R. Freeman, Past-President and Honorary Member of the Society. This year the fund will permit an allowance of $2,000, of which $400 will be made available on award of the scholarship, and the balance in eight monthly installments of $200 each.

Lending Service Extended by Engineering Societies Library

THE NEW RULING of the Board of the Engineering Societies Library will be of interest to members in that it further extends the services the Library is prepared to render to engineers. In the past only some five or six hundred volumes—duplicate copies—have been available for loan outside the Library. By the new ruling, all members in good standing of the four Founder Societies are permitted to borrow books, at a nominal charge, from the general collection of some 150,000 items. The same privilege is extended to non-private and non-commercial libraries.

The new lending rules in full are as follows:

1. Volumes from the Library's general collection will be lent only to members in good standing of the Founder Societies (the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers), and to non-private and non-commercial libraries. Volumes from the duplicate collection will be lent to any person establishing his responsible character to the satisfaction of the Director.

2. Volumes declared by the Director to be rare books or reference books will be lent only after approval by the Executive Committee.

3. Serial publications will be lent only after they have been bound.

4. A minimum charge of fifty cents per volume, which includes expense for insurance and postage to the borrower, will be made to all persons.

5. For each volume retained by the borrower longer than one week, a rental of five cents per day will be charged.

6. No volume from the Library's general collection will be lent for a period longer than ten days plus time for transit to and from the borrower, except with specific approval of the Executive Committee.

7. No individual may have more than three volumes on loan in his name at any one time, and no library may have more than five volumes on loan in its name at any one time.

8. No loans will be made outside the continental United States and Canada.

Requests for loans should be addressed to the Engineering Societies Library, 29 West 39th Street, New York, N.Y. Members are asked to give their society affiliation when writing about loans.

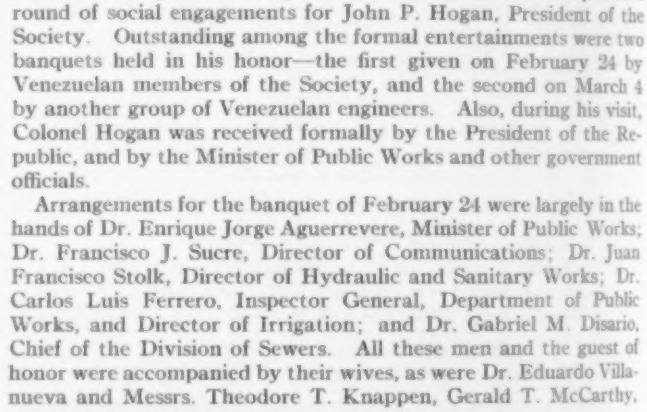
As in the past, the Library is equipped to furnish photostats, black-on-white prints, or microfilm copies of material in its collections. The price of photostats (negative prints) is now 30 cents a print, including postage. A discount of 5 cents a print can be obtained on personal orders by members of the Founder Societies who mention their society affiliation. Positive prints can also be supplied, at a charge of 30 cents per print in addition to the cost of the negative. Microfilm copies can be had at a cost of 4 cents per exposure (usually one page), with a minimum charge of $1.25 per volume or piece. Although for obvious reasons this copying service is confined to Library property, where possible the Library will endeavor to secure copies for members from other libraries, or will refer them to places where such copies may be had.

For the benefit of members who wish to photograph material in the Library, a copying stand is available for use with the member's own camera.

Venezuela Welcomes President Hogan

THE ENTHUSIASTIC welcome accorded him by Venezuelan engineers and the press well nigh turned a recent business trip into a round of social engagements for John P. Hogan, President of the Society. Outstanding among the formal entertainments were two banquets held in his honor—the first given on February 24 by Venezuelan members of the Society, and the second on March 4 by another group of Venezuelan engineers. Also, during his visit, Colonel Hogan was received formally by the President of the Republic, and by the Minister of Public Works and other government officials.

Arrangements for the banquet of February 24 were largely in the hands of Dr. Enrique Jorge Aguerrevere, Minister of Public Works; Dr. Francisco J. Sucre, Director of Communications; Dr. Juan Francisco Stolk, Director of Hydraulic and Sanitary Works; Dr. Carlos Luis Ferrero, Inspector General, Department of Public Works, and Director of Irrigation; and Dr. Gabriel M. Disario, Chief of the Division of Sewers. All these men and the guest of honor were accompanied by their wives, as were Dr. Eduardo Villanueva and Messrs. Theodore T. Knappen, Gerald T. McCarthy,



A PART OF CARACAS, CAPITOL OF VENEZUELA

V. de Chelminski, L. A. Lovell, and G. Amberg. Also present were Mr. S. T. Drew and Miss Drew, Mr. E. V. Barret and Miss Barret, Misses McBride and María Cristina Vivas Pérez, Drs. Carlos Anglade, J. M. Ibarra Arezo, and A. Duarte Level, and Messrs. Geo. C. Bunker, G. A. O'Connor, D. A. Dunkle, J. B. Bond, J. M. Bayot, J. A. Jove, E. Blackie, L. P. Frate, F. Levys, and H. A. Butters.

At the banquet given by Venezuelan engineers on March 4 Dr. Amós Alemán, in proposing a toast to Colonel Hogan, said: "We have made this meeting a sign of friendship and appreciation and also have taken this opportunity to send to the North American engineers through Colonel Hogan, as one of their foremost representatives, our message of good will together with an invitation for closer collaboration in the future, between the professionals of both the northern and southern continents of this peaceful hemisphere."

The Trylon and Perisphere of the New York World's Fair followed Colonel Hogan south, turning up at this second banquet in the form of a huge floral decoration. Present at the event were Drs. E. J. Aguerrevere, Fco. J. Sucre, A. Vegas, J. Sanabria, L. Urbaneja, A. Vidal, E. Vidal, A. Alemán, Isaac Pérez, A. Sosa, E. V. Barret, S. Gutierrez, E. Stolk, J. Elguezabal, J. Croes, J. Bayot, F. Martinez, F. Ayala, A. G. Otero, E. Loynáz, L. Chataing, C. Anglade, C. Domínguez, A. Ponte Valery, McCarthy, Lovell, Lindsay, V. de Chelminski, W. Stone, Fco. Acevedo, J. Vicentini, P. Hurtado Navarro, R. Rodriguez V., A. Paul, and A. Marsal Zárraga.

Later, in an interview published in *El Universal*, Colonel Hogan had an opportunity to reply publicly to the greetings of Dr. Alemán. He expressed the belief that the European war "has created a greater solidarity among the nations of America," and thanked the Venezuelan engineers—"in my own name and in the name of the Society"—for the cordial reception.

Minutes of March Society Meeting

As previously announced, a meeting of the Society was called for March 20, 1940, at Headquarters, for the purpose of canvassing ballots on two proposed amendments to the Constitution. The meeting was called to order by President John P. Hogan, who appointed the following members as a committee of tellers to conduct the canvass: William H. Yates, chairman, William Allen, David G. Baillie, Jr., C. L. Dalzell, S. J. Harwi, William S. LaLonde, Jr., George S. Murphy, Benjamin Schwerin, Alan Lee Slaton, and Clarence E. Boesch. Following the canvass, Chairman Yates of the Tellers Committee reported the results as noted in full in the following item. There being no other business, the meeting was adjourned.

Report of Tellers on Constitutional Ammendments Re "Article IV—Dues" (Proposal No. 1) and "Article X—Ammendments" (Proposal No. 2)

To the Secretary *March 20, 1940*
American Society of Civil Engineers

The Tellers appointed to canvass the Ballot on Amendments to the Constitution report as follows:

Total number of ballots received		9,331
Ballots excluded from the canvass:		
From members in arrears of dues	22	
Without signature	12	
With illegible signature	1	
Total ballots not canvassed		35
Total ballots canvassed		9,296

Proposal No. 1

Yes	404
No	4,305
Blank	5
Void	3
Total	4,717
Total votes counted on Proposal No. 1 (Yes or No)	4,709
Required to carry	3,140
Lost by	2,736

Proposal No. 2

Yes	3,669
No	901
Blank	5
Void	4
Total	4,579
Total votes counted on Proposal No. 2 (Yes or No)	4,570
Required to carry	3,047
Carried by	622

Respectfully submitted,

William H. Yates, *Chairman*

William S. LaLonde, Jr. — Alan Lee Slaton
C. L. Dalzell — David G. Baillie, Jr.
George S. Murphy — S. J. Harwi
Benjamin Schwerin — William Allan
Clarence E. Boesch

Tellers

The J. Waldo Smith Fellowship

The J. Waldo Smith Fellowship in Hydraulics is available for the year September 1, 1940, to September 1, 1941. This fellowship carries $1,000, of which $600 is the stipend of the fellow with as much as necessary of $400 to cover the cost of materials and equipment to the laboratory where he is located. These materials and equipment will become the property of the laboratory at the end of the fellowship term.

This fellowship is limited to those universities and colleges, hereinafter called institution, at which a Student Chapter of the American Society of Civil Engineers is established. The fellow must be between 21 and 27 years of age and be a Junior of the Society; he must be recommended and sponsored as hereafter provided.

Applications for this fellowship should be addressed to the Secretary of the Society by the appropriate officer or head of the department of engineering, who should submit the names, records, and photographs of the candidate or candidates he recommends and sponsors. The application should also be accompanied by a statement describing the laboratory facilities available in sufficient detail to govern the committee in its decision.

The fellow must devote at least one half of the entire year to the problem which the committee will assign. The remainder of his time may be devoted to securing collegiate credits, and the time devoted to the assigned problem may be counted as he may arrange with the institution. Just before the end of the year, the fellow shall submit to the committee a complete report, analysis, and discussion of his work. This report may also serve as his thesis and may be published, in whole or in part, with the appropriate acknowledgments approved by all parties, including the fellow, the institution, and the Society.

As above indicated, it is the intention that the committee shall select for this award both the fellow and the institution, emphasis being placed primarily on the qualifications of the fellow including his record, his qualifications, and his promise for the future. Due but not controlling consideration will also be given to the equipment and facilities available at the institution.

This fellowship is restricted to study in the field of practical hydraulics as distinguished from the purely theoretical approach. To this end, emphasis will be placed on experiments designed to further knowledge of the laws of hydraulic flow rather than to the type of research which proceeds with mathematical analyses on the basis of premises of unknown validity. The essence of this procedure is to test current assumptions and to develop a better understanding of hydraulic flow in general. This line of approach was a characteristic of the great success of the founder of this fellowship, whose generosity has made it available. It is thus appropriate that the methods he followed should be developed and extended.

The committee now considers that the problem assigned for the coming year will be that stated below, but will be glad to receive suggestions of other problems which may be submitted with the application.

Problem. The determination of the extent to which entrained air is carried along by water in a circular pipe laid on a down grade. The pipes should range through a variety of sizes from about 6 in. up, and the effect should be studied of the variation (*a*) in the diameter of the pipe, (*b*) in the slope of the pipe, (*c*) in the roughness of the pipe, (*d*) in the velocity of flow, (*e*) condition of partial vacuum, (*f*) method of mixing, as by free fall and over the high point in the line, and a hydraulic jump within the pipe.

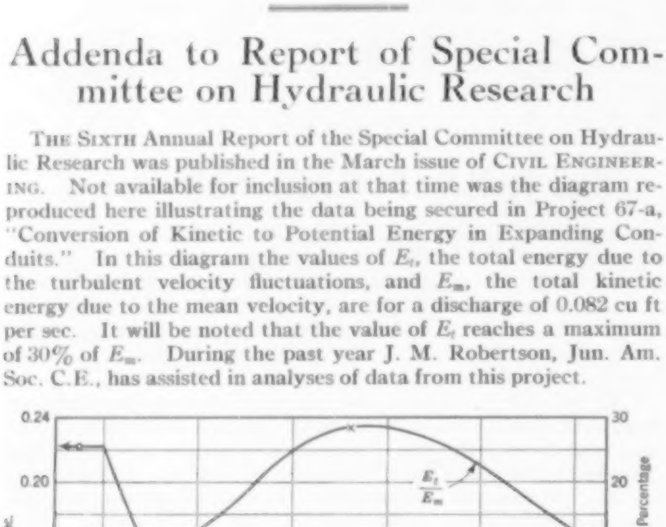
The problem is one of practical importance in determining the necessity for the installation of air valves, their type and size.

No applications will be received after July 1, 1940, and the award will be made as soon thereafter as possible. The committee is empowered to reject all applications.

COMMITTEE ON J. WALDO SMITH FELLOWSHIP
Roger W. Armstrong
C. M. Allen
Karl R. Kennison, *Chairman*

Addenda to Report of Special Committee on Hydraulic Research

THE SIXTH Annual Report of the Special Committee on Hydraulic Research was published in the March issue of CIVIL ENGINEERING. Not available for inclusion at that time was the diagram reproduced here illustrating the data being secured in Project 67-a, "Conversion of Kinetic to Potential Energy in Expanding Conduits." In this diagram the values of E_t, the total energy due to the turbulent velocity fluctuations, and E_m, the total kinetic energy due to the mean velocity, are for a discharge of 0.082 cu ft per sec. It will be noted that the value of E_t reaches a maximum of 30% of E_m. During the past year J. M. Robertson, Jun. Am. Soc. C.E., has assisted in analyses of data from this project.



VARIATIONS OF ENERGY ALONG EXPANDING CONDUIT

The committee wishes to acknowledge the continuing financial support of the Engineering Foundation for the various research projects under its sponsorship, in addition to support from the universities themselves.

Further Analysis of Factual Survey

A report on the "Factual Survey of Members" conducted in the summer of 1939 was published in "Civil Engineering" for February 1940. E. P. Goodrich, formerly chairman of the Society's Committee on Salaries, has since made the following additional analysis of data from the nearly 8,000 returns.

A FURTHER ANALYSIS has been made of the data secured in the Factual Survey of the membership of the American Society of Civil Engineers as of the year 1938, with reference to the salaries reported by the men who occupied the positions at each age who were at the top of the lowest 10%, 25%, 50%, 75%, and 90%, respectively. These data have also been compared with the report of the U.S. Department of Labor as to "Income and Earnings in the Engineering Profession" for the years 1929, 1932, and 1934.

According to Serial No. R588 of the Department of Labor, Bureau of Labor Statistics, the incomes of the above percentiles were highest in 1929 and decreased in approximately uniform ratios to 1932 and 1934, being lowest in the latter year for the three years studied. The Labor Department figures used for comparison include the annual earnings for 30,032 engineers in all branches of the profession. Specific figures are given in Table V of the report cited for varying ages and age groups.

The data as to the earnings of the 8,000 (approximate) members of the Society who reported, were analyzed for each individual age from 21 to 75, inclusive, and for all ages above 75 in one group. For all ages the incomes reported by members of the Society for the year 1938 were higher than were those reported by the Labor Department for the year 1934. This was also the case with reference to the year 1932 except for a few ages from about 27 to 30 for the 75% man, and from about 25 to 40 for the 90% man, but even the differences at those ages were generally less than $100 per year.

Comparing the 1938 earnings of members of the American Society of Civil Engineers with the earnings of all engineers for the year 1929, however, the 1929 figures were higher than those for 1938, except for men over 50. As to the latter, there was practically no difference except that the 90% men earned more in 1938 than in 1929 for men above 65.

The following table gives the figures for the members of the American Society of Civil Engineers for five-year age intervals for each of the percentages mentioned above, with a very few slight adjustments to smooth the curves.

EARNINGS OF REPORTING MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS FOR 1938 FOR GIVEN AGES AND PERCENTILES

AGE	10%	25%	50%	75%	90%
25	800	1,300	1,700	2,000	2,200
30	1,700	2,000	2,400	2,700	3,100
35	2,300	2,600	3,100	3,600	4,500
40	2,600	3,100	3,700	4,600	6,000
45	2,700	3,400	4,200	5,400	7,600
50	2,900	3,600	4,600	6,100	8,000
55	2,700	3,700	4,900	6,800	10,000
60	2,500	3,600	4,900	7,500	11,000
65	2,200	3,500	5,000	8,500	12,000
70	1,500	2,500	5,000	7,500	10,000

Southeastern Conference of Student Chapters Convenes

ON MARCH 13 and 14 the University of Alabama Student Chapter, with the assistance of the Chapter at Alabama Polytechnic Institute, was host to the Southeastern Conference of Student Chapters at Tuscaloosa, Ala. About 70 students were present from six Chapters—Alabama Polytechnic Institute, Georgia School of Technology, University of Alabama, University of Florida, University of Kentucky, and Tulane University. Faculty advisers, contact members, and officers of the Alabama Section met with the students and rounded out a very satisfactory attendance.

Following registration early Wednesday morning, the delegates took advantage of the "open house" engineers' exhibit held in the new engineering building at the University of Alabama. At noon there was a luncheon followed by an inspection trip to the Gulf States Paper Mill. Later in the afternoon the students gathered for an informal tea dance, one of the features of the traditional "St. Pat's Day" celebration, while the Annual Engineers' Ball climaxed the day's activities.

Thursday the conference got into full swing, with A. C. Polk, Director of the Society, making the first address. Colonel Polk's subject was "What I Expect of a Young Engineer." During the technical session that followed five student papers were presented, the speakers being W. E. Blessey and William Tompkins, of Tulane University; H. J. Weaks, of the University of Kentucky; Harold Sullivan, of the University of Florida; and Robert Dees, of Alabama Polytechnic Institute. Walter E. Jessup, Field Secretary of the Society, then commented on the fact that for five successive years the Tulane Chapter has won the President's letter of commendation and suggested that the group try to find out just how Tulane did it. An hour's profitable discussion of Chapter programs followed.

At one o'clock about 75 sat down to a formal luncheon at the McLester Hotel. The toastmaster—E. B. Davis, of the University of Alabama Chapter—had provided himself with a fund of stories that turned the meeting into a tall-story-telling convention. Each delegation—the University of Kentucky with 14 representatives had the record—was presented with a token of the esteem of the University of Alabama Chapter.

The afternoon session began with the taking of a group photograph on the library steps, after which there was an address on

"Federal Civil Service for Engineers." This was given by D. H. Barber, district engineer for the Water Resources Branch of the U.S. Geological Survey. The technical session was then resumed, and the following students read papers: G. S. Murphy, of Alabama Polytechnic Institute; A. R. Morgan, of the Georgia School of Technology; and C. C. Davis, Jr., of the University of Alabama.

A board of judges consisting of Director Polk, G. J. Davis, Jr., and Roy S. Garrett announced the winners of Section prizes. The first prize of $15 went to A. R. Morgan for his paper on "The Atlanta Sewerage System"; second prize of $10 to C. C. Davis, Jr., for his paper on "The Tuscaloosa Lock and Dam"; and third prize of $5 to W. E. Blessey for his paper on "The Bonnet Carré Spillway." H. J. Weaks received honorable mention for his paper entitled "The Engineer in Soil Conservation Service." Messrs. Morgan and Davis have been employed on the projects they wrote about; thus their papers were more than mere reiteration of another's report.

The Conference closed with a business meeting, at which it was decided to hold the next Conference in Atlanta as guests of the Georgia School of Technology. The officers selected for the coming year are R. K. Browning (University of Kentucky), president; W. W. Gibbs (University of Florida), vice-president; and H. C. Van Arsdale (Georgia School of Technology), secretary-treasurer.

1940 Year Book to Be Distributed with April "Proceedings"

Issued as Part 2 of Proceedings, the 1940 Year Book of the Society will be mailed to the membership on April 15. It incorporates all corrections in position and address reported by members up to the first of February. The personnel of Society committees, the officers of Local Sections, and other general information, however, have been corrected up to March 1.

In format and arrangement, the new book follows the style of the preceding issues. The policy adopted in 1938 of including in the Year Book the Annual Report of the Board of Direction has been continued. Increase in membership and other general information will account for approximately thirty additional pages.

Three Months Left for Mead Prize Entries

Once again Juniors and students are reminded that July 1, 1940, is the end of the first competition year for the newly established Daniel W. Mead prizes for the promotion of the study of ethics. As previously announced, for Juniors the topic is "Ethics for Sales Engineers"; for students, "Ethics for Engineering Students." The minimum length of paper is 2,000 words.

Under the rules, as published in the November 1939 issue of Civil Engineering, papers to be considered for the award must first be presented before a Local Section, a Local Section Conference, a Student Chapter, or a Student Chapter Conference. It is not the intention, however, that any Junior or student should be prevented from competing on account of inability to present his paper in person or in full before such a group, and it will be deemed sufficient if the paper is read by a substitute, or presented by title only. In fact, it is expected that several of the papers submitted will fall in this category

Junior Interest in Local Sections

Concern over the lack of Junior interest in Local Section affairs is expressed editorially in a recent issue of the *Georgia Section News*. It is pointed out that in the Atlanta area the proportion of Juniors to total membership is only about 16%, as against 25%, for the Society as a whole, so that "for some reason the Atlanta area is not getting its proper share of Juniors." Moreover, no Juniors attended the January meeting of the Section, and only one was present at the February session.

"Thus it seems," continues the editorial, "that in Atlanta the Society is not interested in the Juniors nor the Juniors in the Society. This is a sad state of affairs which should be corrected if correction is at all possible . . . . The whole question is certainly deserving of careful consideration.

"It would appear that with an active Student Chapter at Georgia Tech there should be several new Juniors each year. It is true, of course, that many of the Tech men leave the state upon graduation. However, there are many who remain in Georgia and the Atlanta area. Is the Georgia Section falling down in its responsibility to the Student Chapter?

"The non-attendance of Juniors at the regular meetings of the Section is difficult to account for. Several find it impossible to attend luncheon meetings and others apparently feel that the Section is controlled by a clique of old friends who care little about the Juniors. Perhaps an occasional evening meeting or program put on by the Juniors might help the situation."

The Georgia Section has taken the first step in solving the problem by outlining it frankly to its entire membership, and by putting its finger on a number of possible causes. Perhaps there are other Sections with similar difficulties, and certainly there are still others that have already found an answer meeting at least their own needs—that is, an answer other than the "Junior Forum" idea, which might be difficult of application with a total of only 15 Juniors within easy reach of the meeting point. Discussions of successful approaches to the problem should be of value, and will be welcomed in future issues of Civil Engineering.

Appointments of Society Representatives

Dudley T. Corning and Francis P. Witmer, Members Am. Soc. C.E., have been appointed Society delegates to the annual meeting of the American Academy of Political and Social Science, to be held at the Bellevue-Stratford Hotel in Philadelphia, April 12 and 13.

John de N. Macomb, Assoc. M. Am. Soc. C.E., has been appointed to represent the Society at the ceremonies presenting the Washington Award to Daniel Cowan Jackling at the Drake Hotel in Chicago on April 15

Forecast for April "Proceedings"

Permissible Composition and Concentration of Irrigation Water

By W. P. Kelley

A brief treatise on the salinity of irrigation water.

Progress Report of the Committee on Flood Control

An appraisal of methods of correlating data, with special reference to hydrometeorological studies, floods in close succession, statistical methods, inventory of flood data, recent publications, cooperation between agencies, and floods caused by ice. (*See February "Forecast."*)

Design of Hinges and Articulations in Reinforced Concrete

By George C. Ernst, Assoc. M. Am. Soc. C.E.

Treatise on Mesnager and Considère joints, originally planned for February "Proceedings."

Progress Report of the Committee on Oxygen Cutting (Flame Cutting) of Structural Steel

Review of the Welding Research Committee's "Survey of the Literature," with six conclusions pertaining to welding practice.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies in 40 States

Doctors Held Subject to Anti-Trust Laws

In a decision of fundamental interest to all professional men, the Court of Appeals of the District of Columbia recently ruled that the prohibitions against acts in restraint of trade in the Sherman Act are applicable to the medical profession and, by implication, to organized action by members of all other professions as well.

The case arose out of the opposition of the American Medical Association, the Medical Society of the District of Columbia, and certain other organizations and individuals to the Group Health Association, a cooperative the members of which paid regular dues into a fund used to defray their expenses for medical care and hospitalization. The medical societies, it is charged, conspired to prevent the successful operation of this plan by forbidding members to affiliate with this plan, upon penalty of expulsion, or to serve as consultants to doctors so affiliated. They are further alleged to have obstructed the admission of Group Health patients into local hospitals.

In December 1938, a federal grand jury returned an indictment charging conspiracy in restraint of trade on the ground that these actions constituted a violation of the anti-trust act. In July 1939, the indictment was dismissed by the District Court on the ground that the practice is not a "trade" within the meaning of the act. It is this decision that has now been overruled in a unanimous opinion by a three-judge Court of Appeals. An appeal to the U.S. Supreme Court for a final determination of the issue is anticipated.

Certain significant quotations from the 16-page opinion are:

"The common law governing restraints of trade has not been confined, as defendants insist, to the field of commercial activity ordinarily defined as 'trade,' but embraces as well the field of the medical profession . . . . We must hold that a restraint imposed upon the lawful practice of medicine . . . and of a lawful organization for the financing of medical services to its members, is just as much in restraint of trade as if it were directed against any other occupation or employment or business . . . . "

"Defendants say that what they are charged with doing amounts to no more than the regulation of membership in the society and the selection of the persons with whom they wish to associate; that under their rules disobedient members may lawfully be disciplined . . . . We recognize that in personal conduct and in professional skill the rules and canons so established have aided in raising the standards of medical practice to the advantage of the whole country. . . . Notwithstanding these important considerations, it cannot be admitted that the medical profession may, through its great medical societies, either by rule or disciplinary proceedings legally effectuate restraints as far-reaching as those now charged. 'An act harmless when done by one may become a public wrong when done by many acting in concert' . . . ."

"Organizations and rules which have as their purpose the improvement of conditions in any particular trade or occupation, and the regulation of relations between traders, are . . . beneficial rather than detrimental to the public interest. But when these same organizations go so far as to impose unreasonable restraints on the operating in their fields, they become subject to the prohibition of the Sherman Act . . . . "

The court's ruling constitutes a signal victory for Assistant Attorney General Thurman Arnold, who is currently carrying his drive against trade restrictions into fields hitherto regarded as exempt from prosecution. In the building construction industry his campaign has already resulted in the return of 65 indictments naming 556 defendants, including 39 labor unions and 110 labor officials, as well as many contractors and their associates.

Supreme Court to Review Federal Rule Over Power

The much disputed question of how far up the tributaries of navigable streams the federal government can constitutionally extend its authority has at last reached the Supreme Court of the United States, which on March 4 agreed to review lower court decisions regarding the necessity for a Federal Power Commission license for the $11,000,000 hydroelectric development of the Appalachian Power Company on the New River at Radford, Va.

This case has had a tangled legal history extending over the last fifteen years, during which the plant has been built and placed in operation. The power company has consistently refused to apply for a federal license on the ground that the New River is not navigable and federal jurisdiction does not apply. The government contends that the New River is legally a navigable stream and that, furthermore, the project will affect navigation on the Kanawha River, into which it flows, and the Ohio River further down. It asks an injunction prohibiting operation of the plant until a license is applied for and granted.

A ruling that the plant requires a license will subject the power company to certain requirements regarding operation of the plant, and will also mean that it can be recaptured by the government at the end of 50 years.

Engineering Projects Hit by Economy

Continuation of the drive by Congress to reduce below budget recommendations appropriations for the fiscal year beginning July 1, 1940, has resulted in a number of cuts affecting engineering work of various kinds.

The War Department appropriation bill for non-military activities was reported to the House of Representatives only after its Appropriations Committee had eliminated a $15,000,000 item to begin the construction of a third set of locks for the Panama Canal. In its plan the committee recommended $850,000 for the preparation of plans and specifications, stating that to begin construction at present would be "premature." This action was upheld by the House itself in passing the bill.

Also eliminated from the bill was $800,000 for dredging a channel at Wake Island in the Pacific Ocean. As passed by the House, the measure appropriated $70,000,000 for general flood control, or $63,000,000 less than the appropriation for the current year; $30,000,000 for flood control on the lower Mississippi River, a cut of $9,000,000; and $66,721,510 for river and harbor improvements, or nearly $30,000,000 below the current level. Also approved was $30,098,771 for work on the Panama Canal not connected with the new locks, but largely designed to strengthen its defenses.

Economy also trimmed the Interior Department Appropriation bill, from which the Appropriations Committee cut almost $3,000,000, bringing the total down to about $119,000,000 as compared with $148,000,000 appropriated last year. Specific cuts included $1,247,000 from the U.S. Geological Survey, principally from a proposed fund for mapping strategic areas of military importance. This item represented an attempt to procure more funds for mapping, a proposal long favored by American Engineering Council. It was ruled out on the ground that an expenditure for military purposes should not be included in the Interior Department bill.

Changes in Labor Board Proposed to Congress

As the result of a long investigation of the policies and administration of the National Labor Relations Board, a special committee of the House of Representatives has submitted a report proposing a drastic reorganization of that body, and a bill to that purpose has been introduced. Two members of the five-man committee submitted a dissenting report strongly opposing the proposed changes.

Besides limiting in a number of specific ways the powers now exercised by the Board, the majority of the committee recommends a complete separation of its authority to investigate and issue complaints from its judicial power to render decisions and issue orders to make such decisions effective. The former would be placed in the hands of an Administrator who, with his staff, would act as a prosecutor; the latter would be concentrated in a new three-man board which would take no part in the preparation or presentation of a case, but would merely hear evidence from both sides and render judgment.

Other proposed changes include limitations upon the Board's authority to issue subpoenas and to determine the unit appropriate for collective bargaining. It is also proposed to apply to its trials the same rules of evidence used in the courts, and to permit employers greater latitude in appealing to it and in expressing opinions on labor matters, providing they are not "accompanied by acts of threats of discrimination, intimidation, or coercion." The Board would also be relieved of the duty of determining which of two rival labor organizations is the appropriate collective bargaining unit—a duty which has many times placed it in an unenviable position

as arbiter between unions affiliated with the A. F. of L. and the C.I.O. One other change would deny to the Board authority to order the reinstatment of an employee who has willfully engaged in "violence or unlawful destruction or seizure of property" and would limit awards of back pay to a maximum period of six months.

War Affects United States

Several repercussions of the European War upon the economy of the United States have been noted during the past month. Figures compiled by the Maritime Commission indicate that since September 15, 1939, 106 vessels have been transferred from American registry as the result of sales to citizens of other countries, as compared with only 54 during the entire year preceding the outbreak of the war. The vessels include all types of ships from small motor boats, tugs, and barges, up to large freighters and tankers. In age, they range from 20 to 50 years.

News association reports indicate that plans of Great Britain and France to spend an estimated $1,000,000,000 in this country for the purchase of aeroplanes are temporarily in suspense pending approval by the Allied Supreme War Council and the working out of a priority plan with officials of the American Army and Navy.

Great Britain's action in forbidding vessels to carry coal from Germany to Italy may result in the purchase of considerable amounts of fuel in this country. Unofficial reports from Rome indicate that the Italians are quietly negotiating for the purchase of some 3,000,000 tons of bituminous coal in the United States, provided suitable credit arrangements can be made.

Ickes Stresses Policy of Conservation

In a lengthy statement on the seventh anniversary of the present administration, the Department of the Interior points out that, since its establishment in 1849, its objectives have been completely reversed. At that time, when national resources seemed limitless, its whole purpose was their exploitation. Of recent years, however, attention has shifted to conservation and, it is claimed, more has been done in this direction during the past seven years than during the preceding ninety-one.

Major points of accomplishment claimed by Secretary Harold L. Ickes include:

- Establishment of "prudent grazing practices" on 134,000,000 acres of public domain through the cooperation of the livestock industry.
- Increased opportunities for agriculture through irrigation of semi-arid lands.
- Advance in mine safety and development of helium.
- A "higher degree" of self-government and the fostering of native culture for Indians.
- Advancement of a "broad program for social and economic betterment in the Nation's far-flung territories."
- Greater industrial opportunities in the Pacific Northwest through development of hydroelectric power at the Bonneville and Grand Coulee projects on the Columbia River.
- "Additional opportunities for public enjoyment in the national park areas."

Washington, D.C.
March 11, 1940

Maryland-District of Columbia Student Chapter Conference

The George Washington University Student Chapter will be host to the Maryland-District of Columbia Conference of Student Chapters in Washington, D.C., on April 26. The program for the day will include inspection trips to construction projects near Washington, as well as the technical presentations and business session of the conference.

An innovation has been planned for the dinner to follow the day's events. The speaker for the evening will discuss some non-technical subject of general interest, as it is felt that engineers should be abreast of current problems.

Four years ago the George Washington University Chapter was host to the first meeting of the Maryland-District of Columbia Conference. It is hoped that the second series of meetings which is now being inaugurated will be even more successful than the first round of meetings.

News of Local Sections

Scheduled Meetings

Cincinnati Section—Dinner and annual meeting at the Student Union, University of Cincinnati, on April 9, at 6:30 p.m.

Cleveland Section—Luncheon meeting at the Guildhall on April 8, at 12:15 p.m.

Colorado Section—Dinner meeting at the University Club on April 8, at 6:30 p.m.

Dayton Section—Luncheon meeting at the City of Dayton Incinerator on April 15, at 12:15 p.m.

Georgia Section—Luncheon meeting at the Atlantan Hotel on April 14, at 12:30 p.m.

Kansas State Section—Dinner meeting at the Kansan Hotel in Topeka on April 26, at 6:30 p.m.

Los Angeles Section—Dinner meeting atthe University Club on April 10, at 6:30 p.m.

Metropolitan Section—Technical meeting in the Engineering Societies Building, New York City, on April 17, at 8 p.m.

Miami Section—Dinner meeting at the Alcazar Hotel on April 4, at 7 p.m.

Michigan Section—Dinner meeting at the Intercollegiate Club in Detroit on April 19.

Nashville Section—Dinner meeting at Kissam Hall, Vanderbilt University, on April 2, at 6:30 p.m.

North Carolina Section—Two-day annual meeting at the Carolina Hotel, Pinehurst, April 26 and 27.

Oklahoma Section—Dinner meeting at the University of Oklahoma on April 3, at 6:30 p.m.

Philadelphia Section—Joint inspection, dinner, and meeting with the Engineers Club of Trenton at the Roebling plant and Stacy-Trent Hotel, Trenton, on April 11. Inspection 2:40 p.m.; dinner 6 p.m.

Providence Section—Talk in the Engineering Societies Building, Providence, R.I., on April 10, at 8 p.m.

Sacramento Section—Regular luncheon meetings at the Elks Club every Tuesday at 12:10 p.m.

St. Louis Section—Luncheon meeting on April 22, at 12:15 p.m.

San Francisco Section—Regular dinner meeting at the Engineers' Club of San Francisco on April 16, at 5:30 p.m.

Spokane Section—Luncheon meeting at the Davenport Hotel on April 12, at 12 noon.

Tennessee Valley Section—Dinner meeting of the Chattanooga Sub-Section at the Ross Hotel on April 19, at 6:30 p.m.; dinner meeting of the Knoxville Sub-Section at the S & W Cafeteria on April 9, at 5:45 p.m.

Texas Section—Spring meeting at Galveston, Tex., April 26–27.

Utah Section—Dinner meeting at the University of Utah on April 5, at 6:30 p.m.

Virginia Section—Joint meeting with the A.S.M.E., the A.I.E.E., and the A.I.A., sponsored by the Engineers Club of Hampton Roads at Norfolk, Va., on April 26 (all-day meeting).

Wisconsin Section—Dinner meeting at the Memorial Union, Madison, on April 4, at 6:15 p.m.

Recent Activities

Cincinnati Section—*February 21:* Joint meeting with the Technical and Scientific Societies of Cincinnati. The principal speaker was Dr. A. O. Gage, who gave an illustrated talk on the "Two-Hundred Inch Reflector Telescope." Forty members of the University of Cincinnati Student Chapter were among the 1,200 present. The Section officers for 1940–1941 are Rupert A. Anderegg, president; Fred F. McMinn, vice-president; and Raymond W. Renn, secretary-treasurer.

CLEVELAND SECTION—*February 6:* An illustrated lecture on the Chicago subway system was the feature of the occasion, the guest speaker being Charles E. De Leuw, consulting engineer of Chicago. Mr. De Leuw is acting as consultant to the Department of Subways and Traction of the City of Chicago, and his talk elicited considerable discussion.

COLORADO SECTION—*Denver, February 12:* A symposium on the Green Mountain Dam comprised the technical program. S. F. Crecelius, construction engineer for the U.S. Bureau of Reclamation, discussed local conditions and early construction operations and F. F. Smith, engineer in charge of earth dam design for the Bureau, described progress in design. Both talks were illustrated. During the business meeting it was announced that the Section will establish an award of Junior membership in the Society to be given annually to the outstanding Student Chapter graduate at Colorado State College. The Section maintains a similar award at the University of Colorado.

CONNECTICUT SECTION—*New Haven, January 24:* The guests of honor on this occasion were John P. Hogan, President of the Society, and George T. Seabury, Secretary. Both spoke on different phases of Society activities, and a general discussion followed.

DAYTON SECTION—*February 19:* Following a luncheon Walter E. Jessup, Field Secretary of the Society, gave a brief talk on Society affairs. The principal speaker was L. A. Gillett, supervisor of WPA operations for District 2 in Ohio, who discussed the organization of the federal program of public works.

DISTRICT OF COLUMBIA SECTION—*Washington, February 15:* A brief report on the Annual Meeting initiated the program. This was given by Glenn L. Parker, Director of the Society. Then Willard F. McDonald, special assistant to the chief of the U.S. Weather Bureau, spoke on the subject of "Weather Bureau Work as a Service to the Engineering Profession." *Junior Forum:* The following officers have been elected to serve for the coming year: T. Ritchie Edmonston, president; Richard E. Volland, vice-president; and William O. Comello, secretary-treasurer.

GEORGIA SECTION—*Atlanta, February 12:* An illustrated talk on "Problems Involved in Removing Columns from a Tall Building" was the feature of the occasion, the speaker being Robert G. Lose, consulting structural and architectural engineer of Atlanta.

HAWAII SECTION—*Honolulu, February 27:* W. L. Richards, lieutenant commander, C.E.C., U.S. Navy, gave a talk on "Western Pacific Air Bases." He was assisted by Lt. T. L. Davey. A general discussion of the improvements contemplated by the Navy in the western Pacific followed. The Section announces that its officers for 1940 are V. B. Libbey, president; Karl A. Sinclair, vice-president; and James H. Reid, secretary-treasurer.

ILLINOIS SECTION—*February 2:* On this occasion the Section had as its guests of honor Maj. Rufus W. Putnam and A. J. Schafmayer, recent winners of Society prizes for papers in TRANSACTIONS. W. W. De Berard, Director of the Society, gave a résumé of the Annual Meeting held in New York. *Junior Forum:* The new officers for the Forum are J. D. Taylor, president; Gordon L. Jeppesen, vice-president; Lawrence H. Lyle, secretary; and E. C. Cardwell, treasurer.

INDIANA SECTION—*Indianapolis, February 24:* Joint meeting with the Indiana Engineering Council and its allied engineering societies. Field Secretary Jessup and Director De Berard discussed the varying problems of the civil engineering profession before the Section and, later in the day, addressed the joint session on the subject of professional objectives. One of the speakers at the technical meeting of the Indiana Engineering Council—Lawrence Sheridan, regional counselor for the National Resources Committee—was furnished by the Section. Director Root was the speaker at the luncheon meeting, and Vice-President Ferebee at the dinner meeting. In the evening Alonzo J. Hammond, Past-President of the Society and president of the American Engineering Council, discussed the accomplishments and future aims of the Council. The new officers for the Section are J. Emmett Hall, president; L. E. Martin, vice-president; and Denzil Doggett, secretary-treasurer.

IOWA SECTION—*Ames, February 28:* The Section awards of Junior membership in the Society were presented to John C. Akins, of Iowa State College, and Robert A. Schick, of the University of Iowa. Both responded briefly. The other speakers were Dr. J. A. Vieg, of the department of history and government at Iowa State College; Ralph E. Flanders, former president of the American Society of Mechanical Engineers; Anson Marston, Past-President of the Society; T. R. Agg, Director of the Society; and Field Secretary Jessup.

ITHACA SECTION—*February 6:* The feature of the program was an illustrated lecture on the construction of the Iraq pipe line, the speaker being Herbert S. Austin, engineer for the Standard Oil Company of New Jersey. *March 8:* Joint meeting with the Cornell University Student Chapter. Samuel W. Marshall, chief engineer of the Pennsylvania Turnpike Commission, discussed the project.

KANSAS CITY SECTION—*February 8:* An industrial motion picture entitled "Pipe and the Public Welfare" was presented by Joseph W. Ivy, Western sales manager for the National Cast Iron Pipe Company. Mr. Ivy supplemented the film with a talk on the methods and details of manufacturing cast iron pipe.

KANSAS STATE SECTION—*Wichita, February 9*: Annual meeting held in conjunction with the thirty-second annual meeting of the Kansas Engineering Society. During this session the following new officers were elected: F. W. Epps, president; Murray A. Wilson, vice-president; and George W. Lamb, secretary-treasurer.

LOS ANGELES SECTION—*February 14:* A symposium on aviation comprised the technical program, the speakers being W. W. Beman, assistant chief research engineer for the Lockheed Aircraft Corporation, and Rush B. Lincoln, commanding officer for the U.S. Army Air Base, March Field. Mr. Beman's subject was "Recent Developments in Aircraft Design," while Colonel Lincoln discussed "The Air Corps in National Defense."

LOUISIANA SECTION—*New Orleans, February 9:* Following the presentation of numerous committee reports, Edward S. Bres, Director of the Society, discussed the general work of the Society. An illustrated lecture on methods of exploring foundation conditions in clay soil was then presented by Martin Gurtler, of the firm, Lemieux Brothers. During the business session the following new officers were elected: Norman E. Lant, president; J. A. McNiven, first vice-president; F. N. Billingsley, second vice-president; and V. J. Bedell, secretary-treasurer.

MARYLAND SECTION—*February 15:* Dr. Robert K. Greenfield, of the staff of Johns Hopkins University, gave a talk on the Mediterranean situation in relation to the present crisis. Considerable general discussion followed his remarks. *Junior Association, January 9 and February 13:* The first of these sessions was devoted to business discussion. The speaker at the February meeting was Andrew Stubler, a member of the Association, whose subject was "Survey Work and Camp Life in Venezuela."

METROPOLITAN SECTION—*February 21:* A paper on "Public Works Under the Army Engineers" was presented by Julian L. Schley, Chief of Engineers, U.S. Army. General Schley stressed the type of work being carried on with non-military funds allocated to the Corps of Engineers and outlined its functional and engineering character.

MIAMI SECTION—*November 2, December 7, January 4, and February 1:* At the first of these meetings William E. Parker, chairman of the Mapping and Legislative Committee of the Section, gave a paper describing the work of his committee. Then the guest speaker, William P. Cross, associate hydraulic engineer for the U.S. Geological Survey, reviewed the progress of his work on the water conservation survey that he is making in the Miami area. The December and January meetings were devoted to business discussion, and the principal speaker at the February meeting was H. H. Hyman, division manager of the Southern Division of the Florida Power and Light Company. Milton B. Garris has been elected president of the Section, and Leroy S. Edwards, secretary-treasurer.

MICHIGAN SECTION—*Detroit, February 21:* Philip S. Strout, superintendent and director of public relations for the Ernst Kern Company, of Detroit, related his experiences operating a placer gold mine in Idaho and presented a description of the mechanical equipment available for such operations.

MOHAWK-HUDSON SECTION—*Schenectady, February 8:* Joint meeting with the Engineering Societies of Schenectady. The investigation of salary schedules recently conducted by the Society was briefly discussed by Walter E. Jessup, Field Secretary of the Society. Then F. G. Switzer, head of the department of hydraulic

engineering at Cornell University, gave an illustrated lecture on some of the hydraulic developments in progress in the southwestern part of the country.

NORTHEASTERN SECTION—*Boston, January 22:* Election of officers for 1940, held at this time, resulted as follows: C. W. Banks, president; C. A. Farwell, vice-president; and Francis H. Kingsbury, secretary-treasurer. The question of licensing and registration of engineers was discussed by Arthur D. Weston, and announcement was made of the award of certificates of life membership to several members of the Section. The recipients of these certificates are R. H. Beattie, W. A. Clapp, C. A. Holden, E. E. Lochridge, W. H. Norris, O. E. Parks, W. N. Patten, W. M. Peabody, E. A. Taylor, and C. D. Thurber. Talks by President Hogan, Secretary Seabury, and Clarence M. Blair, new Director of the Society, concluded the meeting. All discussed different phases of Society affairs.

NORTHWESTERN SECTION—*Minneapolis, March 4:* The speakers were H. A. Whittaker, director of the Division of Sanitation of the Minnesota State Board of Health; Dr. Thaddeus Surber, technical adviser to the Minnesota State Fish and Game Department; and Walter S. Olson, director of the Division of Drainage and Waters of the Minnesota Department of Conservation. Mr. Whittaker spoke on the subject of "Progress in Reduction of Stream and Lake Pollution in Minnesota," while the two latter discussed the effect of stream pollution on fish propagation.

OKLAHOMA SECTION—*Tulsa, January 19–20:* Held in conjunction with the fifth annual convention of the Oklahoma Society of Professional Engineers. As its part of the program the Section provided one of the technical speakers—J. H. Stratton, of the U.S. Engineer Office at Caddoa, Colo. Captain Stratton gave an illustrated lecture on Conchas Dam. *Stillwater, February 26:* Joint meeting with the Student Chapters at the University of Oklahoma and the Oklahoma Agricultural and Mechanical College, the latter Chapter acting as host. Following a dinner, there were brief speeches of welcome and response by Prof. Ren G. Saxton, faculty adviser for the Chapter at Oklahoma Agricultural and Mechanical College; Prof. J. F. Brookes, faculty adviser for the University of Oklahoma Chapter; and D. L. Wilson, president of the Section. The technical program consisted of talks of D. J. Friedell and E. R. Stapley, of the civil engineering department at Oklahoma Agricultural and Mechanical College, and Gibb Gilchrist, dean of engineering at Texas Agricultural and Mechanical College. The Section states that this was one of the most successful meetings it has ever held.

OREGON SECTION—*February 6:* Simon Perliter, former engineer of design for the Metropolitan Water District of Southern California, discussed the design and construction of the Colorado River Aqueduct and showed two reels of motion pictures of the work there.

PHILADELPHIA SECTION—*February 17:* An informal program of Spanish dances and songs and a magician's performance enlivened "Spanish Night," the occasion of the Section's annual social meeting. An innovation in the program was the presentation of the Edgerton High-Speed Movies, furnished through the courtesy of the Massachusetts Institute of Technology. Charles Haydock gave an introductory talk and commented during the showing of the film. Social dancing concluded the evening.

PITTSBURGH SECTION—*January 30:* The "Arterial Plan for Pittsburgh"—a comprehensive recommendation for improvement of local traffic facilities prepared by Robert H. Moses—was reviewed by Park H. Martin, chief engineer of the Allegheny County Planning Commission. This so-called "Moses Plan" has aroused widespread civic interest and evoked extended discussion.

PROVIDENCE SECTION—*January 15:* An illustrated lecture on "Dams of the West" was presented by W. C. Huntington, head of the civil engineering department at the University of Illinois. Professor Huntington spent a five-month period and traveled 15,000 miles in making his study of these structures.

PUERTO RICO SECTION: The Section announces that its new officers are as follows: Antonio S. Luchetti, president; Robert J. Auld, first vice-president; Salvador Quinones, second vice-president; and Gilberto M. Font, secretary-treasurer.

SACRAMENTO SECTION—*February 6, 13, 20, and 27:* The speakers at these four luncheon meetings were Thomas E. Stanton, Jr., materials and research engineer for the California State Division of Highways; Frederick H. Paget, associate hydraulic engineer for the State Division of Water Resources; Victor A. Endersby, research engineer for the Shell Development Company, Emeryville, Calif.; and Henry D. Dewell, consulting engineer of San Francisco. *Junior Forum, February 14:* Milton Harris, assistant safety engineer for the California State Division of Highways, spoke on the question, "Can the Traffic Engineer Eliminate Accidents?"

ST. LOUIS SECTION—*February 26:* Field Secretary Jessup was present and discussed Society affairs of interest to the Section. He was followed by W. J. Moxom, senior meteorologist of the St. Louis Weather Bureau, who described the work of the Bureau.

SAN DIEGO SECTION—*February 15:* A talk on "Electrical Developments of 1939," given by Herbert Cordes, of the General Electric Corporation, was the feature of the occasion. Pecos Calahan, of the California State Board of Registration for Civil Engineers, was present to answer questions regarding the rules and regulations of the Board.

SAN FRANCISCO SECTION—*February 20:* The speaker was Stephen P. Timoshenko, professor of mechanical engineering at Stanford University, who gave an illustrated lecture on research laboratories he visited last summer in Switzerland, Germany, Poland, Italy, and France. *Junior Forum, January 23:* T. L. Lenzen, of the engineering department of the Standard Oil Company of California, spoke on "Developments in Saudi Arabia." Color motion pictures, taken by Mr. Lenzen last year, depicted his party's crossing of Saudi Arabia from the Red Sea to the Persian Gulf. With Kirk Miles as leader of the affirmative side and John F. Bonner upholding the negative, members discussed the question, "Is the Participation of the Federal Government in the Production of Power a Sound Policy?"

TACOMA SECTION—*February 13:* F. H. Hardy, inspector in charge of the U.S. Coast and Geodetic Survey, described the origin and early history of the Survey and the methods used in the preparation of nautical and aeronautical charts, illustrating his talk by moving pictures and a display of instruments. Captain Hardy was assisted by R. L. Schoppe, C. M. Durgin, and other members of his staff.

TENNESSEE VALLEY SECTION—*Chattanooga Sub-Section, February 20:* Following dinner and the reading of several committee reports, there was an illustrated talk on the construction of Pensacola Dam in northeastern Oklahoma. This was given by E. L. Chandler, former chief construction engineer in charge of the project. *Knoxville Sub-Section, February 6:* A dinner and business meeting preceded the technical program, which consisted of Mr. Chandler's illustrated lecture on Pensacola Dam.

T. J. RODHOUSE, JR. (LEFT), SECRETARY-TREASURER OF THE NEWLY FORMED TRI-CITY SECTION, AND J. STUART MEYERS, PRESIDENT

TRI-CITY SECTION—*Rock Island, Ill., January 15:* Joint meeting with the Reserve Officers Association, the Society of American Military Engineers, and the Illinois Society of Engineers. The speaker of the evening was Charles P. Gross, district engineer for the Rock Island District of the U.S. Engineer Office, who discussed "The Proposed Nicaraguan Barge Canal." Colonel Gross recently returned from Nicaragua, where he headed a commission appointed to prepare a report on the proposed canal. *Moline, Ill., February 9:* A paper on "Engineering Uses of Aerial Photographs," was presented by V. W. McCoy, of the U.S. Engineer Office at Rock Island. Then W. W. De Berard, Director of the Society, gave a report on the Annual Meeting.

VIRGINIA SECTION—*Richmond, February 9:* During the annual business meeting the following officers were elected for the coming year: E. W. Saunders, president; G. M. Bowers, first vice-president; E. S. Thomas, second vice-president; and W. R. Glid-

den, third vice-president. P. A. Rice was reappointed secretary-treasurer. The technical session opened with papers by three Student Chapter delegates to the meeting—H. R. Moore, of Virginia Polytechnic Institute; F. P. Nichols, of the University of Virginia; and Cadet Fred Flowers, of the Virginia Military Institute. Then F. W. Wheeler, designing engineer for the Virginia State Highway Department, spoke on "Highway Bridge Design in Virginia," and Robert S. Thomas, district engineer for the U.S. Engineer Office in Washington, D.C., gave an illustrated paper on the "Washington National Airport." The meeting adjourned for dinner and a social hour, after which certificates of life membership were presented to Ralph N. Begien and James D. Fauntleroy. An illustrated lecture on scenic engineering, given by Miner R. Tillotson, regional director of the National Park Service, concluded the meeting.

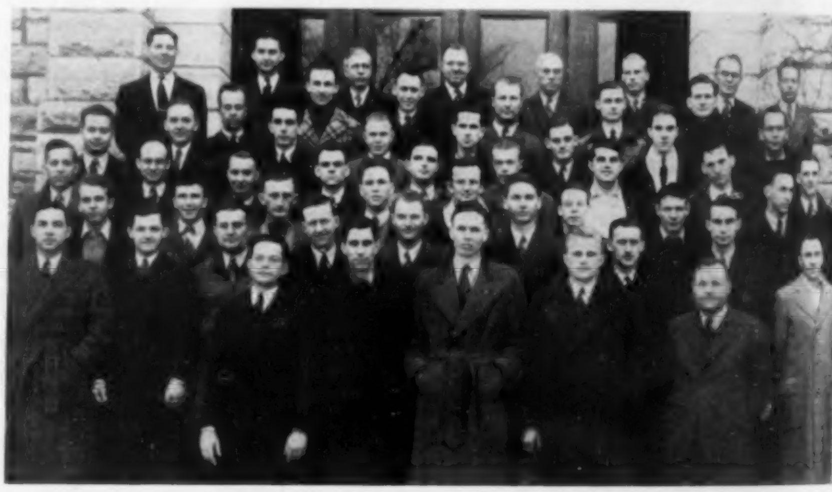
WISCONSIN SECTION—*Milwaukee, February 23:* Joint meeting with the American Welding Society. A short talk on the work of the Federal Bureau of Investigation, presented by the chief of the Milwaukee branch of the Bureau, initiated the program. Then Mr. Lawson, of the Bethlehem Steel Corporation, gave an illustrated lecture on modern steel construction.

Student Chapter Notes

BROWN UNIVERSITY—*February 12:* A member of the Student Chapter—Earl W. Harrington, Jr.—delivered a paper entitled "Legal Equipment of the Surveyor." *February 26:* The student speaker on this occasion was R. F. Garner, who discussed the cause of the change of seasons. A general discussion followed. The students voted the meeting one of the most interesting of the year.

DREXEL UNIVERSITY—*January 25:* John H. Carson, of Carson and Carson, Engineers, gave an illustrated lecture on modern uses and advantages of welding. *February 16:* The Chapter held its first annual dance in the Drexel Tech Student Union Building.

KANSAS STATE COLLEGE—The Kansas State Chapter reports that it is enjoying an interesting and varied year. The list of speakers heard includes Dr. Randall C. Hill, professor of economics at Kansas State College; H. H. Connell, consulting engineer of Salina, Kans.; John A. Long, manager of the County Engineering Division of the American Road Builders' Association; and Dr. Philip Thomas, research engineer for the Westinghouse Electrical and Manufacturing Company. On one occasion members of the Chapter were guests of the University of Kansas Chapter at a joint meeting with the Kansas State Section. On February 15 the following new officers were elected: Jack P. Fuller, president; Wayne P. Lill, vice-president; George T. Dean, secretary; and Louie Marshall, treasurer.



MEMBERS OF KANSAS STATE COLLEGE STUDENT CHAPTER

LOUISIANA STATE UNIVERSITY—*January 24:* The Chapter inspected the addition and alterations to the Gulf Coast Line railway bridge over the Atchafalaya River at Krotz Springs. *February 20:* On this date the group went to see the repair work being made on the new Charity Hospital Building in New Orleans. These repairs were necessitated by foundation settlement.

NEWARK COLLEGE OF ENGINEERING—*March 4:* A talk on "Job Hunting," given by Eugene MacDonald, of the firm of Parsons, Klapp, Brinckerhoff, and Douglas, was the feature of the occasion. In his talk Mr. MacDonald made a comparison between seeking employment in New York and South America and discussed the advantages and disadvantages of engineering work in the tropics.

OHIO NORTHERN UNIVERSITY—*February 13:* Walter E. Jessup, Field Secretary of the Society, was the Chapter's guest of honor on this occasion and helped the members with their plans for the future. *February 23:* R. B. Wiley, head of the school of civil engineering at Purdue University, was the guest speaker at the Chapter's final program in its Engineers' Week observances. His subject was "Sanitation and the Public." Three motion pictures on the mining and processing of aluminum were shown through the courtesy of the Aluminum Company of America.

PENNSYLVANIA STATE COLLEGE—"Construction Contracting" was the subject of discussion, the speaker being Charles F. Puff, Jr., executive secretary and general manager of the Pennsylvania branch of the Associated General Contractors of America, Inc.

RHODE ISLAND STATE COLLEGE—*January 23:* The Chapter entertained President Hogan and Secretary Seabury at a special luncheon and inspection trip to the Jamestown Bridge. Later in the afternoon Colonel Hogan discussed the Annual Meeting, while Mr. Seabury spoke of the organization of the Society and of the advantages of membership in it.

SOUTHERN METHODIST UNIVERSITY—*March 1:* A banquet was held to celebrate the organization of the Student Chapter at Southern Methodist University. Lewis R. Ferguson, in the capacity of toastmaster, called on Prof. Sophus Thompson to introduce the members of the new Chapter. Then Lawrence W. Wells, president of the Dallas Branch of the Texas Section, was introduced, and Walter H. Meier discussed his appreciation of the Dallas Branch. Others who spoke briefly were John A. Focht, secretary-treasurer of the Texas Section; Dean E. H. Flath, of Southern Methodist University; and Ernest Myers, of the Dallas Technical Club.

TULANE UNIVERSITY: From December 26 to 30 members of the Chapter were guests of the 2d New Orleans District of the U.S. Engineer Office on a trip up the Mississippi aboard the government steamer *Mississippi*. Stops were made at Vicksburg, where the group inspected the models in the U.S. Waterways Experiment Station, and at Natchez where they observed the progress of construction on the Mississippi River bridge there.

UNIVERSITY OF KANSAS CHAPTER cordially invites all Student Chapters to attend the Spring Meeting of the American Society of Civil Engineers to be held in Kansas City, Mo., on April 17, 18, and 19. The Chapter is planning a very interesting student conference at this meeting, the program of which is included in this issue, and hopes that all can attend.

UNIVERSITY OF PENNSYLVANIA—*February 22:* The Chapter was addressed by Charles B. Conwell, of the Edward G. Budd Company. Mr. Conwell discussed the work of his company.

UNIVERSITY OF TENNESSEE: The Chapter reports that it has held three meetings this year—one devoted to the election of officers and the others to talks on engineering subjects. One of the speakers was Charles P. Wright, senior civil engineer for the Tennessee Valley Authority.

WEST VIRGINIA UNIVERSITY—*February 7:* On this date the Chapter sponsored an inspection trip for students and members of the faculty to the Tygart River reservoir dam at Grafton, W.Va.

ITEMS OF INTEREST

About Engineers and Engineering

Civil Engineering for May

Continual emphasis and debate on the power and flood control features of TVA has tended quite naturally to obscure the importance of that Authority's progress in a wide variety of other undertakings. In the May issue, J. W. Bradner, Jr., in a paper entitled "An Engineer Looks at the TVA," surveys these somewhat neglected fields, "to show how the TVA is applying engineering principles and methods in solving some of the acute social and economic problems of the southeastern states." Development of phosphate fertilizer, stimulation of the ceramics industry, and design of new agricultural equipment are only a few of the items discussed.

In May, also, Brehon B. Somervell will present his second article on the New York Municipal Airport, and J. A. Meehan, continuing the series of papers on the Port of New York, will give special attention to the work of the Department of Docks—particularly as regards layout and design of piers.

The second group of hydrologic studies by senior students at Washington University is also on the schedule. One of these is an analysis of mean hourly rainfall, in which it is shown that perhaps 45% of the precipitation may occur at rates twice the mean hourly rate. The other study breaks down annual rainfall into its probable intensity occurrence in such a way as to permit "a much more definite estimate of that part of watershed yield coming from surface runoff than has been possible through any of the relationships heretofore applied."

Previously announced for the April issue, Charles V. Theis's discussion of the source of water derived from wells will appear in May. Rounding out the issue will be articles of interest to structural engineers ("Static Tests of Riveted Joints," by Jonathan Jones), to highway engineers ("Trends in Modern Highway Practice," by Murray D. Van Wagoner), and a review of "Legal Registration of Professional Engineers," by T. Keith Legaré that should appeal to all groups.

Navy Engineering Vacancies to Be Filled by Examination

Examination of candidates for appointment to the Civil Engineer Corps, U.S. Navy, has been authorized to fill five vacancies in the commissioned grade of assistant civil engineer, with rank of lieutenant (junior grade). Applications for the preliminary (non-assembled) examination should be filed with the Chief of the Bureau of Yards and Docks before April 15, 1940.

To be eligible for these examinations candidates must be between the ages of 22 and 30 on April 1, 1940. They must be graduates in engineering of an approved college or university and must have had two years and eight months of engineering practice, on April 1, 1940, at least two years of which have been subsequent to graduation.

Those found qualified by their preliminary examination may appear in Washington in June for physical and written professional examinations. The latter will last approximately four days and will pertain to such engineering subjects as are embraced in the practice of the Civil Engineer Corps of the Navy. The five receiving the highest marks will be offered commissions in the Corps with the rank of lieutenant (junior grade).

The Civil Engineer Corps of the Navy designs and constructs all public works of the Navy, such as Navy yards, air stations, hospitals, magazines and radio stations, and these activities include buildings, dry docks, ship building ways, piers, quay walls, railroads, roads, water supply, sewage disposal, power and heating plants, and distributing systems. The maintenance of these structures is also to a large extent the responsibility of the Corps.

Further details and copies of the application form may be obtained by addressing the Chief of the Bureau of Yards and Docks, Navy Department, Washington, D.C. It should be noted that only two weeks remain for securing and returning these forms.

Professor N. G. Neare's Column

Conducted by

R. Robinson Rowe, M. Am. Soc. C.E.

At the next meeting of the Engineers Club after the world had gasped at the news of the simultaneous discoveries of the Northeast and Northwest Poles by Haddah Nipp and Hans Tuck, Prof. N. G. Neare again introduced the famous pair, and the intrepid Nipp volunteered a few words in response to the ovation.

"Time was nearly our undoing," he said in part. "Your distinguished confrere, Professor Neare, had warned us that if I started for the Northeast Pole at the same instant Hans set out for the Northwest Pole, each traveling 2,500 miles per day, we would not arrive at the same instant.

"Although separated, we each soon realized that correction of time because of change in longitude would require that I make my first 2,500 miles in 22 hours, as I would have departed nearly 27° of longitude that day. As friend Tuck would have made time corrections in the opposite direction, he would have been four hours behind me at this point. Since this was not the intent of our gentlemen's agreement, I adjusted my flight to the original suggestion of 100 miles per hour.

"By a happy coincidence, Hans did the same, and it was Nipp and Tuck to the goal after that.

"Of course everybody knows now that we found both the Northeast and Northwest Poles at the North Pole. If I had maintained the rate of 2,500 miles per day, I would have waited for Hans and we would have raised our flags together. By the way, Noah, just how long would I have waited?"

"It would have seemed like a couple of eternities, but it might have been only one, depending on your fancy," replied the Professor, which left us with something to think about.

Add "Piscatorial Research" File

Someone in the Miami Section spotted the "fish-weight formula" in the January issue of Civil Engineering, and as a result it was on the program for "formal" discussion at the Section meeting on February 1. On that occasion, with all due solemnity, H. H. Hyman presented a written paper purporting to analyze the Waddell formula ($W = LG^2/800$, where W is the weight of the fish in pounds, L its length in inches, and G its maximum girth in inches).

"It is apparent," said Mr. Hyman, "that Dr. Waddell started out with two cones placed base to base. This would represent in the ultimate a gulf-streamlined fish. The common circumference of the bases of the cones represents the girth of the fish, and its length would be twice the altitude of the cones."

He then proceeded formally to show that on this assumption, "the volume or content of a gulf-streamlined fish" would equal $LG^2/40$. Then, to get the weight, "another constant must be taken into consideration which must compensate for shape, specific gravity, age, speed, density, and 'fin-angling.' This constant is evidently $^1/_{20}$, and Dr. Waddell arrived at it because by using 800 (that is, 20×40) his formula gave splendid results."

Now comes the pay-off. According to Mr. Hyman:

"The constant of $^1/_{20}$ is substantiated by the fact that Dr. Waddell fished in the twentieth century, that his fishing trips extended over a period of at least 20 days, that a fish story is usually 20 times as long as it is broad, and that 800 seemed to be about right. Dr. Waddell's total catch during these fishing trips usually covered 20 different species of the finny tribe. He caught 20 or more fish a day or said nothing about it. Probably he fished 20 times before getting his first strike and got 20 strikes before landing his first fish. Maybe Professor Seward told him 20 was his lucky number.

"I know some fishermen, not anglers, who, had they developed this formula, would have used 700 as the constant, so as to make the fish weigh heavier, but had I worked it out, I probably would have arrived at a constant of 900 so as not to exaggerate—rather let the fish show up on the other side of the stream.

"To clinch the matter—the fact that Dr. Waddell caught 802 fish in slightly more than 20 days on his 1932 Florida trip proves conclusively that 800 is 'the stuff,' for the number of fish caught (802) as compared to this corrected constant of 800 is as 2 compared to 800, or only 1/4 of 1% out of the 'weigh.' Q. E. D."

New Officers of A.W.W.A.

THE American Water Works Association has announced its officers-elect for the year 1940 as follows: president, Norman J. Howard of Toronto, Ont.; vice-president, Louis R. Howson, M. Am. Soc. C.E., of Chicago; treasurer, W. W. Brush, M. Am. Soc. C.E., of New York. Terms of these men begin during the Kansas City convention of A.W.W.A., which immediately follows the Society's own meeting in that city.

Omitted from last month's list of Society members receiving A.W.W.A. awards was W. V. Weir of St. Louis, who was selected for the Diven Medal for 1940 for his outstanding work as chairman of the association's Committee on Distribution System Records.

NEWS OF ENGINEERS

Personal Items About Society Members

JAMES H. POLHEMUS, for the past four years executive vice-president of the Portland General Electric Company, Portland, Ore., has been elected president of the company.

JOHN L. STEPHENS, who is on the staff of the Great Northern Railway Company, has been transferred from the position of assistant to the division roadmaster at Whitefish, Mont., to that of assistant master carpenter, with headquarters at Grand Forks, N.Dak.

ALBERT C. KLINGENBERG recently severed his connection in the engineering division of the PWA in Washington, D.C., to accept a position as engineer with the claim department of the Fidelity and Deposit Company of Maryland and the American Bonding Company of Baltimore. He is located in Baltimore.

A. K. MORGAN is now chief engineer for the Palisades Interstate Park Commission, with headquarters in New York City.

J. W. GREEN, senior bridge engineer with the California Division of Highways, has been appointed southern representative of the Bridge Department in charge of its Los Angeles office. Mr. Green was assistant engineer of design on the construction of the San Francisco–Oakland Bay Bridge.

IRVING L. JOHNSON, formerly assistant district manager of the Raymond Concrete Pile Company at Los Angeles, Calif., is now staff engineer with Donald R. Warren, consulting structural and civil engineer of Los Angeles.

UEL STEPHENS is opening a consulting office in Fort Worth, Tex., where he will specialize in municipal problems. Until February 1 Mr. Stephens was regional engineer and assistant regional director for Region No. 5 of the PWA, with headquarters at Fort Worth.

FRANKLIN A. MARTINE has resigned his position with the International Boundary Commission at San Benito, Tex., to accept employment as architectural-engineer examiner in the Department of Public Works of the City of Dallas, Tex.

EVERETT K. MCDONALD, previously city engineer of Decatur, Ill., is now secretary for the J. M. Driscoll Company, a general contracting firm in Decatur.

MARTIN W. WATSON, general contractor of Topeka, Kans., has been elected vice-president of the Associated General Contractors of America.

ANDREW P. ROLLINS and T. C. FORREST, JR., have organized a new consulting engineering firm, to be known as Rollins and Forrest. Their offices are in the Praetorian Building, Dallas, Tex. Mr. Rollins has been serving as director of public works of Dallas, and Mr. Forrest was at one time a member of the firm, Myers, Noyes and Forrest.

ALLSTON DANA, for the past fifteen years engineer of design for the Port of New York Authority, is now employed in the special engineering division of the Panama Canal Zone.

ORRIS BONNEY, assistant city engineer of Columbus, Ohio, has been appointed coordinator of the Columbus WPA, which is to be expanded.

WALTER L. WOODWARD has resigned as draftsman for the Wyoming State Highway Department to accept a position in the water facilities branch of the U.S. Soil Conservation Service, with headquarters at Billings, Mont.

WILLIAM B. HUFFINE, associate engineer with the Public Roads Administration, has been transferred to the Denver (Colo.) office of the Administration, where he will serve as assistant to the senior highway engineer. For the past four years Mr. Huffine has been manager of the Wyoming State-Wide Planning Survey.

ARTHUR S. TUTTLE and ELWYN E. SEELYE, New York City consulting engineers, announce their association for the practice of engineering at 101 Park Avenue, New York City.

EDWARD W. DAVIDSON was recently transferred from his position as associate engineer on the Bonneville Project at Portland, Ore., to that of civil engineer for the U.S. Navy Department on the construction of the new Naval Air Station at Kodiak, Alaska.

G. C. STREET, JR., until lately state engineer inspector for the PWA for Texas and New Mexico, has been appointed regional director of the Wage and Hour Division of the U.S. Department of Labor for Region XIV, embracing Texas, New Mexico, Oklahoma, and Arkansas. His headquarters are in Dallas, Tex.

R. M. MERRIMAN is now chief tunnel engineer for the Pennsylvania Turnpike Commission. He is located at Everett, Pa.

ROBERT M. LINGO, formerly resident engineer for A. W. Hefling, of Hutchinson, Kans., has been made chief engineer for the Municipal Power and Light Plant at Casey, Ill.

WILLIAM F. SMITH has accepted a position as area engineer for the WPA at Houston, Tex. He was previously construction engineer for Wharton County, Texas.

WILHO N. SUOMINEN is now an engineer for the General Chemical Company at Camden, N.J.

B. T. HUDSPETH, until recently assistant structural engineer for the Golden Gate International Exposition, has taken a position with the Permanente Cement Company.

W. H. WOOD has resigned as director of the materials and tests division of the Texas State Highway Department to become connected with the Rubber Associates, Inc., of New York City. His headquarters will be in Austin, Tex.

JOHN F. HALPIN is now in the Civil Engineer Corps of the U.S. Navy, being stationed in the public works office of the 3d naval district, New York City. He was formerly assistant engineer for the New York Central Railroad.

J. W. BARNETT, former chairman of the Georgia State Highway Board, has returned to the Georgia State Highway Department as engineer in charge of grade crossing work.

JOSEPH E. BORG, previously structural draftsman for the American Bridge Company, has joined the staff of the structural engineering department at Fenn College, Cleveland, Ohio.

ARTHUR W. BUSHELL, for many years on the staff of the Connecticut State Highway Department, has been appointed director of the newly formed division of engineering and construction.

PAUL S. REINECKE, who is in charge of the St. Louis district office of the U.S. Engineer Office, has been advanced from the rank of lieutenant colonel to that of colonel.

PHILIP T. SAMUEL has been transferred from Washington, D.C., where he was in the office of the Chief of Engineers, to Philadelphia, Pa., where he will be chief of the newly organized marine division in the U.S. Engineer Office in that city.

GANO DUNN, president of the J. G. White Engineering Corporation, New York City, has been awarded the decora-

tion of the Order of Honor and Merit by the Haitian government "for his service in the economic upbuilding of the republic."

BRUCE L. CORMACK has severed his connection with the American Bridge Company in order to accept a position in the industrial engineering department of the Carnegie Illinois Steel Corporation. At present his headquarters are at Braddock, Pa.

DECEASED

WILLIAM WEBSTER CHADSEY (Assoc. M. '12) superintendent of the Schenectady County Highway Department, died in Schenectady, N.Y., on February 11, 1940, at the age of 59. Mr. Chadsey spent his entire career in Schenectady—for a number of years as assistant city engineer in charge of all sewer construction and of all city engineering except buildings. Later he maintained a civil and sanitary engineering practice, and from 1933 on he was superintendent of the Schenectady County Highway Department.

JAMES GEIGER COXETTER (Assoc. M. '20) major, U.S. Army (retired), Fort Bragg, N.C., died recently at the age of 59. Major Coxetter was in the U.S. Army for many years, serving continuously as captain of field artillery from 1920 to 1934. In the latter year he was retired for physical disability, with the rank of major.

EDWARD RUDDOCK HYDE (M. '36) since 1927 dean of the college of engineering at the University of the Philippines, Manila, P.I., died in that city on February 5, 1940. Professor Hyde, who was 56, had been at the University of the Philippines since 1921. Before that he served as a captain in the Corps of Engineers, U.S. Army, on the construction of fortifications for Manila Bay, and he had also been a bridge designer and chief structural designing engineer in the Manila Bureau of Public Works.

ROBERT JOSEPH JUSTICE (Assoc. M. '31) resident engineer for the Kansas State Highway Commission, Topeka, Kans., died recently at the age of 41. Mr. Justice spent his entire career with the Kansas State Highway Commission, having become connected with it in 1923. He had been resident engineer since 1929. From 1926 to 1928 he was, also, surveyor for Harvey County, Kansas.

HOOD MCKAY (M. '07) engineer for the Susquehanna Coal Company, Philadelphia, Pa., died on Feburary 1, 1940, at the age of 71. From 1891 to 1907 Mr. McKay was with the Lykens Valley Coal Company and the Summit Branch Mining Company at Lykens, Pa., serving successively as district engineer, assistant superintendent, and superintendent. Later he was with the Lehigh Coal and Navigation Company before going to the Susquehanna Coal Company, where he remained for many years.

SAMUEL PHILLIPS MITCHELL (M. '03) consulting engineer and president of the Seaboard Construction Company, Philadelphia, Pa., died on February 11, 1940, at the age of 75. From 1887 to 1906 Mr. Mitchell was, successively, with the Edgemoor Bridge Works and the American Bridge Company. He was president of the American Equipment Company from 1906 to 1925, and of the Seaboard Construction Company from the latter year on. Since 1906 he also maintained a consulting practice, specializing in railroad bridge construction.

CHARLES NICHOLAS MONSARRAT (M. '13) consulting engineer of Montreal, Canada, died suddenly on March 1, 1940, at the age of 68. From 1903 to 1911 Colonel Monsarrat was engineer of bridges for the Canadian Pacific Railway; from 1911 to 1918, chairman and chief engineer of the Board of Engineers for the Quebec Bridge; and from 1918 to 1921, consulting engineer to the Dominion government. Since the latter year he had been in private practice as a member of the consulting firm, Monsarrat and Pratley, of Montreal.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

HERMAN PAUL ODESSEY (M. '36) commanding officer, U.S. Coast and Geodetic Survey, Washington, D.C., died on February 5, 1940, at the age of 41. Mr. Odessey spent his entire career with the U.S. Coast and Geodetic Survey, having become connected with it in 1922. He served as junior officer and chief of party on various projects in all sections of the United States and in the interior of Alaska.

ALEXANDER JENIFER TAYLOR (Assoc. M. '07) president of the Delaware School Foundation, Wilmington, Del., died in that city in February 1940. Mr. Taylor, who was 65, was for a time in the Wilmington Street and Sewer Department and, also, served as city engineer. In 1915 he entered the employ of the du Pont Company, and later assisted the du Ponts and others in the reorganization of the state school system. Regarded as an outstanding engineering authority on school buildings, he was chosen vice-president and chief engineer of the Delaware School Auxiliary (now the Delaware School Foundation). In 1929 he became president. Mr. Taylor was a veteran of the Spanish-American War.

HAROLD EMIL VON BERGEN (Assoc. M. '36) assistant hydraulic engineer, California State Department of Public Works, was drowned near Sacramento, Calif., in the recent (February) flood that swept through the Sacramento Valley. Mr. von Bergen, who was 35, was with the California Division of Water Resources from 1930 to 1933 and, again, from 1935 to 1938. From 1933 to 1935 he was with the U.S. Forest Service as chief of party on road location.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From February 10 to March 9, 1940, Inclusive

ADDITIONS TO MEMBERSHIP

ALEXANDER, GEORGE WILKINS (Jun. '40), 1640 Cambridge St., Cambridge, Mass.

ALSUP, WILLIAM HASKELL (Jun. '39), Supt. of Constr., WPA, Box 911, San Angelo, Tex.

ANDERSON, ERNEST C. (Jun. '40), 12 Sumner Rd., Cambridge, Mass.

ANDERSON, ROBERT LEO (M. '40), Engr. (Structural), U.S. Navy Dept., Washington, D.C. (Res., 4322 Eighteenth St., North, Arlington, Va.)

ANDREWS, DONALD COCHRANE (Assoc. M. '40), Supt., Turner Constr. Co., 420 Lexington Ave., New York (Res., 79-01 Thirty-fifth Ave., Jackson Heights), N.Y.

ARNESON, EDWIN PARK (Jun. '40), Instrumentman, State Highway Dept., San Saba (Res., 301 Grandview, San Antonio), Tex.

ARRASTIA, JUSTO (M. '39), Head, Dept. of Mechanics, Coll. of Eng., Univ. of the Philippines, Manila, Philippine Islands.

BARTON, GEORGE WILLIAM (Assoc. M. '40), Traffic Engr., Chicago Motor Club, 66 East South Water, Chicago (Res., 1612 Forest Ave., Wilmette), Ill.

BOYLES, JESSE VARNEL (Assoc. M. '40), Dist. Director of Operations, WPA, 422 Grant St., Decatur, Ala.

BREWER, WILL (Assoc. M. '40), Asst. Engr., Corps. of Engrs., U.S.A., U.S. Engr. Office, New Federal Bldg., Pittsburgh, Pa.

BROWN, RICHARD FULMER (Jun. '40), Eng. Draftsman, U.S. Engrs. Office, Caddoa (Res., 711 South 6th St., Lamar), Colo.

CALHOUN, FRED HARVEY HALL, JR. (Jun. '40) 330 South Tyron St., Charlotte N.C.

CAPLAN, SALEM DAVID (Assoc. M. '40), Eng. Insp., Dept. of Public Works, Municipal Bldg. (Res., 2205 Creston Ave.), New York, N.Y.

CARSEN, DAVID (Jun. '40), Eng. Asst., Board of Transportation, 69 Pennsylvania Ave., Brooklyn (Res., 10 Bank St., New York), N.Y.

CARSON, CHESTER PEYTON (Jun. '39), Engr., Fruin-Colnon Contr. Co., 502 Merchants-Laclede Bldg. (Res., 5806 Enright Ave.), St. Louis, Mo.

CHAMBERS, ALVIN LEE (M. '40), Asst. Prof. of Testing Materials, Civ. Eng. Dept., Univ. of Kentucky (Res., 827 Sunset Drive), Lexington, Ky.

CLARK, ROLAND AUGUSTUS (Jun. '40), Eng. Draftsman and Librarian, Whitman, Requardt & Smith, West Biddle St. at Charles (Res., 5308 Tramore Rd.), Baltimore, Md.

CLINTON, EDGAR THOMAS (Assoc. M. '40), Y. M. C. A., Omaha, Nebr.

DAVIS, THOMAS V. (Jun. '40), Elec. and Structural Draftsman, Imperial Irrig. Dist., Imperial, Calif.

DOWD, GAYLORD CLARK (Jun. '40), Civ. Engr., Stewart-Kingscott Co., 208 Elm St., Kalamazoo, Mich.

DROGIN, LEONARD ROBERT (Jun. '40), Junior Civ. Engr., Civ. Aeronautics Authority, 14th and L Sts. (Res., 1716 N St., N.W.), Washington, D.C.

ELLIOTT, THOMAS COLGATE (Jun. '39), Draftsman, N. & W. Ry., Eng. Dept., Roanoke, Va.

EVANS, GEORGE (Jun. '39), Junior Engr., U.S. Bureau of Reclamation, 406 Custom House (Res., 3485 West 32d Ave.), Denver, Colo.

FEREBAUER, ROBERT WOODALL (Jun. '39), Asst. Engr. Aide, U.S. Forest Service, Idaho City, Idaho.

FIALA, JOHN JOSEPH (Jun. '39), Eng. Cadet, Bridge Design Section, New York City Dept. of Public Works, 125 Worth St. (Res., 410 East 84th St.), New York, N.Y.

FLANNERY, JOHN PATRICK (Jun. '40), Engr., Decatur Contr. Co., 1455 Blondell Ave., Pelham Bay (Res., 8829 Fort Hamilton Parkway, Brooklyn), N.Y.

FORD, PAUL GLENN (Jun. '40), 220 Federal Bldg., Asheville, N.C.

FRIEDRICH, LAWRENCE MAX (Assoc. M. '39), Asst. Prof., Civ. Eng., Univ. of Toledo, Bancroft St., Toledo, Ohio.

FRYE, CLARE ALANSON (Assoc. M. '40), Chf., Regional Eng. Div., SCS, U.S. Dept. of Agriculture, 318 Center Bldg. (Res., 35 Overhill Rd.), Upper Darby, Pa.

GAYNER, JERROLD MILTON (Jun. '39), Junior Bridge Engr., State Bridge Dept. (Res., 2480 Portola Way), Sacramento, Calif.

GOODWIN, HENRY JOHN (Jun. '40), Junior Engr., U.S. Eng. Dept., Prado Dam, 920 South Parton St., Santa Ana, Calif.

GRAND, ROBERT SHOAL (Assoc. M. '40) Constr. Supt. and Engr., The Austin Co., 19 Rector St., New York, N.Y. (Res., 585 Montello St., Brockton, Mass.)

GRAY, NOMER (Assoc. M. '40), Eng. Insp., Dept. of Public Works, City of New York, Municipal Bldg. (Res., 2934 Valentine Ave.), New York, N.Y.

GURRY, JOHN WILLIAM (Jun. '40), Junior Engr., U.S. Geological Survey, 945 Post Office Bldg., Boston, Mass.

HART, WILLARD CLARENCE (Jun. '39), County Engr. of Constr., WPA, 706 North 11th (Res., 1331 Olive St.), Murphysboro, Ill.

HERRON, WILLIAM ROACH (Jun. '39), Draftsman, Edmonds Art Stone Co., 2135 Queens Chapel Rd., N.E. (Res., 1730 Park Rd., N.W.), Washington, D.C.

HODGES, THOMAS VICTOR (M. '40), Asst. Director of Waters, Dept. of Forests and Waters, Room 463 Edu. Bldg. (Res., 42 Taylor Boulevard), Harrisburg, Pa.

HOEPPNER, FREDERICK JOHN (Jun. '39), Estimator, Designer, Hoeppner-Bartlett Co., 631 East Madison St. (Res., 305 Garfield Ave.), Eau Claire, Wis.

HOLSER, FLOYD LESTER (M. '40), Deputy Administrator, WPA, 1206 Santee St. (Res., 761 South Sierra Bonita Ave.), Los Angeles, Calif.

HOMER, JOHN WENDELL (Jun. '39), Junior Engr., International Boundary Comm., Box 821, San Benito, Tex.

HUDSON, ROBERT FRANKLIN (Jun. '39), Draftsman, New England Power Assoc., 42 Main St., Leominster (Res., 58 Farragut Rd., Swampscott), Mass.

HYLAND, RICHARD VINCENT (M. '40), (Madigan-Hyland), 28-04 Forty-first Ave., Long Island City, N.Y.

INGLIS, CLAUDE CAVENDISH (M. '39), Director, Central Irrig. and Hydrodynamic Research, Govt. of India, Poona, India.

KERNAN, FRANCIS FREDERICK (Assoc. M. '40), Office Engr., City Engrs. Office, City Hall (Res., 7537 Trenton Ave.), University City, Mo.

KOHN, ARTHUR (Jun. '40), Sales Engr., Fleming Structural Steel Co., 411 Neal St. (Res., 113 East Moody Ave.), New Castle, Pa.

TOTAL MEMBERSHIP AS OF MARCH 9, 1940	
Members	5,604
Associate Members	6,371
Corporate Members	11,975
Honorary Members	31
Juniors	6,168
Affiliates	70
Fellows	1
Total	18,245

KUTCHERA, DON HENRY (Jun. '40), Junior Engr., National Park Service, 300 Keeline Bldg., Omaha, Nebr.

KUTCHERA, RALPH JOHN (Jun. '39), Junior Agri. Engr., SCS, Buffalo, Okla.

LEAVY, EDMOND HARRISON (M. '40), Maj., Corps of Engrs., U.S.A., 70 Columbus Ave., New York (Res., 74 Park Ave., Bronxville), N.Y.

LEHMANN, KENNETH FREDERICK (Jun. '40), Min. Engr., Oliver Iron Min. Co. (Res., 2113 Seventh Ave., East), Hibbing, Minn.

LESLIE, JOHN WILLIAM (Jun. '40), Asst. Engr., U.S. Engr. Office, 31 St. James Ave., Boston, Mass.

LEVITT, STANLEY MANUAL (Jun. '39), Bridge Detailer, State Highway Comm., Box 781, Baton Rouge, La.

LUSTBADER, EDWARD EMANUEL (Jun. '40), Junior Estimator, Asst. Supt., Psaty & Fuhrman, Inc., 369 Lexington Ave., New York (Res., 220 Corbin Pl., Brooklyn), N.Y.

MALLEY, ALEXIS PETER (Assoc. M. '40), Elec. Eng. Designer, Utilities Eng. Bureau, Public Utilities Comm., City and County of San Francisco, 425 Mason St., San Francisco, Calif.

MANLEY, KENNETH GRANT (Assoc. M. '40), State Safety Consultant, WPA, 1826 West McDowell Rd., Phoenix, Ariz.

MERRITHEW, WILLIAM STERLING (Assoc. M. '40), Asst. Engr., Met. Water Dist. of Southern California, 306 West 3d St., Los Angeles (Res., 133 San Miguel Rd., Pasadena), Calif.

MONEYMAKER, BERLEN CLIFFORD (Assoc. M. '40), Senior Geologist, TVA, 203 Union Bldg., Knoxville, Tenn.

MUNGER, HAROLD HAWLEY (Assoc. M. '40), Research Asst., Dept. of Applied Mechanics, Kansas State Coll., Manhattan, Kans.

NORTON, ERIC COLBURN (Assoc. M. '39), Senior Claims Engr., State Dept. of Public Works, State Office Bldg., Albany (Res., 197 Delaware Ave., Delmar), N.Y.

OGBURN, THOMAS JEFFERSON, III (Jun. '40), Junior Bridge Design Engr., State Highway Dept., State Highway Bldg., Richmond, Va.

PAGE, WILLIAM BIRNEY (Jun. '39), R. F. D., Sebago Lake, Me.

RAHLVES, AUGUST HENRY WILLIAM (Jun. '39), Junior Eng. Aide, Corps of Engrs., U.S.A., 121 Custom House, San Francisco (Res., 2005 Eighty-ninth Ave., Oakland), Calif.

RAYCROFT, CHAUNCY WILLIAM (Assoc. M. '40), Associate Engr., Regional Office 1, PWA, 301 Nassau St., Princeton, N.J.

ROCHEFORD, GEORGE EDWARD (Jun. '40), Insurance Insp., Factory Insurance Assoc., 555 Asylum St. (Res., 44 Garden St.), Hartford, Conn.

RUTH, MURRAY ALAN (Assoc. M. '40), Asst. Engr., U.S. Engrs., War Dept., U.S. Govt., Post Office Bldg., Cincinnati, Ohio (Res., 22 Linden Ave., Fort Thomas, Ky.)

SANER, CURTIS CHARLES (M. '40), Associated with Haile & McClendon, 308 Scanlon Bldg., Houston, Tex.

SARDIS, JOHN MICHAEL (Jun. '39), With U.S. Engrs., Auburn (Res., 202 Roselawn Ave., Modesto), Calif.

SAVAGE, WILLIAM TERRELL (Jun. '39), Rodman, State Highway Dept., Box 454, Floydada (Res., 2203 Twenty-eighth St., Lubbock), Tex.

SCOTT, ROBERT PINEY (Jun. '39), Office Engr., Middle Rio Grande Conservancy Dist., Court House (Res., 507 Lafayette Pl.), Albuquerque, N.Mex.

SEATON, JOHN EDGAR (Jun. '39), Junior Engr., North Eastern Const. Co., 812 Nissen Bldg., Winston-Salem, N.C.

SEAWELL, VOLNEY RICHARD (M. '40), Director, Div. of Operations, WPA, 1206 Santee St. (Res., 525 South Gramercy Pl.), Los Angeles, Calif.

SHILTS, WALTER LEONARD (Assoc. M. '40), Head, Dept. of Civ. Eng. and Asst. Dean of Eng., Univ. of Notre Dame, Box 1413, Notre Dame, Ind.

SMITH, THOMAS ROY (M. '40), Engr., U.S. Bureau of Reclamation, Friant, Calif.

SORENSEN, ARNE SEVERIN (Jun. '39), Junior Civ. Engr., SCS, 211 Sonna Bldg., Boise, Idaho.

STENBERG, JACK EMORY (Assoc. M. '40), Senior Project Mgr., U.S. Indian Service, Box 63, Fort Washakie, Wyo.

STINNER, ROBERT LEO (Jun. '39), With Pennsylvania Water Co., Wilkinsburg (Res., 14 Norman St., Duquesne), Pa.

STRONG, ROBERT WALLACE (Jun. '39), Draftsman, State Highway, Bridge Dept., Capitol Bldg. (Res., 239 Johnson St.), Santa Fe, N.Mex.

THOMPSON, WILLIAM ROBERT (Jun. '40), Care U.S. Engrs., 1214 Fifth Ave., Huntington, W.Va.

THOMSEN, JOHN WILLIAM (M. '40), Vice-Pres., Stupp Bros. Bridge & Iron Co., 3800 Weber Rd., St. Louis, Mo.

VERNER, EDWIN ABERCROMBIE (Assoc. M. '40), With Shell Oil Co., 100 Bush St., San Francisco (Res., 711 Masonic Ave., Berkeley), Calif.

VON DER LINN, ARTHUR WILLIAM (Assoc. M. '40), Technical Representative, Wm. P. McDonald Constr. Co., Box 190, Flushing (Res., 114-33 Two Hundredth St., St. Albans), N.Y.

WEBER, ROBERT CHARLES (Jun. '40), Junior Eng. Draftsman, TVA, 711 Union Bldg. (Res., 1628 Yale Ave.), Knoxville, Tenn.

WILBERDING, MARION XAVIER (M. '40), Pres., Wilberding Co., Inc., 808 Seventeenth St., N.W. (Res., 2833 Twenty-ninth St., N.W.), Washington, D.C.

WILLIAMS, FREDERICK HASTINGS (Jun. '39), Asst. Instr., Alabama Polytechnic Inst., Box 224, Auburn, Ala.

WILSON, BASIL WRIGLEY (Assoc. M. '40), Asst. Engr., Research, Chf. Civ. Engr.'s Office, South African Railways and Harbours, Johannesburg, Union of South Africa.

WYMAN, JACK A. (Assoc. M. '40), Area Engr., WPA, 2055 Harney Bldg. (Res., 3416 California St.), Omaha, Nebr.

YEE, JEWETT CHU YICK (Jun. '39), Junior Naval Archt., Navy Yard, Pearl Harbor (Res., 1828 Fort St., Honolulu), Hawaii.

MEMBERSHIP TRANSFERS

AMIRIKIAN, ARSHAM (Assoc. M. '30; M. '40), Design Engr., Navy Dept., Bureau of Yards and Docks, Washington, D.C. (Res., 6536 Western Ave., N.W., Chevy Chase, Md.)

BENSON, CHARLES BEVERLEY (Assoc. M. '23; M. '40), Prin. Statistician (Eng.), New York Public Service Comm., 80 Centre St., New York (Res., 44 Highridge Rd., Hartsdale), N.Y.

CAFONE, RALPH GEORGE (Jun. '32; Assoc. M. '40), Junior Administrative Asst., U.S. Forest Service, CCC, 411 State House Annex, Trenton (Res., 27 Roma St., Nutley), N.J.

CLINE, FREDERICK (Jun. '30; Assoc. M. '40), Associate Engr., U.S. Engr. Office, 751 South Figueroa, Los Angeles, Calif.

DANNER, ELLIS (Jun. '30; Assoc. M. '40), Asst. Highway Engr., State Div. of Highways, Mt. Hawley Rd. (Res., 303 Columbia Terrace), Peoria, Ill.

DAWSON, CHARLES OATLEY (Jun. '30; Assoc. M. '40), Instr., Dept. of Civ. Eng., Univ. of New Hampshire, Durham, N.H.

DELSON, ISIDORE (Assoc. M. '16; M. '40), Asst. to Dept. Commr., Bureau of Bridges, Dept. of Public Works, City of New York, 18th Floor, Municipal Bldg., New York, N.Y.

ELL, CARL STEPHENS (Assoc. M. '21; M. '40), Pres., Northeastern Univ., 360 Huntington Ave., Boston, Mass.

EUSTIS, ERNEST LEWIS, JR. (Jun. '38; Assoc. M. '40), Asst. Seismologist, Caribbean Petroleum Co., Maracaibo, Venezuela.

FARQUHAR, FRANK SHAW (Jun. '31; Assoc. M. '40), Eng. Aid, U.S. Biological Survey, Wash-

ington, D.C. (Res., 59 Park Ave., Winthrop, Mass.)

Gena, John Stirling (Assoc. M. '22; M. '40), Asst. Chf. Engr., Muskingum Watershed Conservancy Dist., 1319 Third St., N.W. (Res., 606 East High Ave.), New Philadelphia, Ohio.

Goldman, Perry Joseph (Jun. '33; Assoc. M. '40), Engr., Golder Constr. Co., Inc., Market St. National Bank Bldg. (Res., The Croydon, 49th and Locust Sts.), Philadelphia, Pa.

Gribbin, John Breslin (Jun. '32; Assoc. M. '40), Technical Teacher, T. R. Proctor School, Hilton Ave., Utica, N.Y.

Hanning, Willis Cosine (Jun. '23; Assoc. M. '28; M. '40), Chf. Engr., Dept. of Housing and Buildings, Borough of Queens, 21-10 Forty-ninth Ave., Long Island City (Res., 6623 Ridge Boulevard, Brooklyn), N.Y.

Leonard, James Irving (Assoc. M. '26; M. '40), Senior Engr., Board of Public Utility Commrs., State of New Jersey, 1060 Broad St., Room 601, Newark, N.J.

Lowey, Leslie Lawrence (Jun. '34; Assoc. M. '40), Structural Steel Draftsman, Design Div., Dept. of Boro Works of Manhattan, 2120 Municipal Bldg., New York (Res., 140-18 Ash Ave., Flushing), N.Y.

McGraw, William Harold (Jun. '34; Assoc. M. '39), Asst. Bridge Engr., State Div. of Highways, California State Bldg., Los Angeles (Res., 1943 Milan St., South Pasadena), Calif.

Maschmeyer, William Louis (Jun. '37; Assoc. M. '39), Asst. Engr., U.S. Engrs., Sardis, Miss.

Manasseh, Nicolas Elia (Jun. '31; Assoc. M. '39), Civ. Engr., Iraq Petroleum Co., Ltd., Haifa, Palestine.

Martin, George Earl (Jun. '14; Assoc. M. '18; M. '40), Cons. Engr., The Barrett Co., 40 Rector St., New York, N.Y.

Morava, John Hall (Jun. '29; Assoc. M. '40), Salesman, Carnegie-Illinois Steel Corporation, 208 South La Salle St., Chicago, Ill.

Mortola, Alexis Joseph (Jun. '38; Assoc. M. '40), Transitman, Grade 4, Designs Div., Bureau of Sewers, with Borough Pres. of Queens, Borough Hall, Long Island City (Res., 83-44 Lefferts Boulevard, Kew Gardens), N.Y.

Palo, George Payne (Jun. '28; Assoc. M. '40), Associate Engr., TVA, Knoxville, Tenn.

Parker, Antoine Panet (Jun. '33; Assoc. M. '40), Structural Engr., Frank S. Parker, 533 West 57th St., New York, N.Y.

Paterson, John Lamb (Assoc. M. '38; M. '39), Archt. and Civ. Engr. (Palmer & Turner), 17 Canton Rd., Shanghai, China.

Pedgrift, Delmore George (Jun. '31; Assoc. M. '40), Engr., Permanente Corporation, Box 29, San Jose (Res., 6526 Dana St., Oakland), Calif.

Penna, Leo Amaral (Jun. '34; Assoc. M. '40), Asst. Hydr. Engr., Emprezas Electricas Brasileiras, S.A., Av. Rio Branco 137–14°, Rio de Janeiro, Brazil.

Shuler, Tom Crawford (Assoc. M. '23; M. '40), Maintenance Engr., Muskingum Watershed Conservancy Dist., 3d St., N.W. (Res., 137 Fourth St., S.E.), New Philadelphia, Ohio.

Sutton, William Godfrey (Assoc. M. '23; M. '39), Prof., Civ. Eng., Univ. of Witwatersrand, Box 1176, Johannesburg, Transvaal, Union of South Africa.

Thibodeau, George Frederick (Assoc. M. '31; M. '40), Treas., Thibodeau Constr. Co., Inc., Railroad Ave. (Res., Four Winds), Wolfeboro, N.H.

Thomas, Roy James (Jun. '37; Assoc. M. '40), Asst. Civ. Engr., TVA, Dept. of Operations, Wilson Dam, Ala.

Thompson, T. Sanford (Jun. '23; Assoc. M. '32; M. '40), Asst. Engr. Designer, Board of Water Supply, 346 Broadway, New York (Res., 947 Eightieth St., Brooklyn), N.Y.

Tribble, John Furman (Assoc. M. '36; M. '40), Prin. Civ. Engr., Materials Div., State Highway Dept., State Highway Bldg. (Res., 17 Walnut St.), Montgomery, Ala.

Tyler, Ivan Louis (Assoc. M. '27; M. '40), Concrete and Materials Engr., Pennsylvania Turnpike Comm., 11 North 4th, Harrisburg, Pa.

Vaccaro, George (Jun. '36; Assoc. M. '40), Structural Engr., Dept. of Public Works, City of New York, Room 1400, Municipal Bldg., New York (Res., 335 Humboldt St., Brooklyn), N.Y.

Walker, William Sefton (Jun. '37; Assoc. M. '39), Mgr., Transportation and Golden Triangle Div., Pittsburgh Chamber of Commerce, Seventh Ave., Pittsburgh, Pa.

Waugh, William Rushing (Jun. '30; Assoc. M. '40), Associate Materials Engr., TVA, Hiwassee Dam, N.C.

Willims, Leon G. (Assoc. M. '24; M. '40), Res. Engr., Greeley & Hansen, 110 Cherry St., (Res., 2231 Glenwood Ave.), Toledo, Ohio.

Reinstatements

Auriemma, Alfred Anthony, Jun., reinstated Feb. 29, 1940.

Foster, William Southmayd, Jun., reinstated Feb. 26, 1940.

Orr, Joseph Anderson, Assoc. M., reinstated Feb. 26, 1940.

Pfeifer, Frederick Joseph, Assoc. M., reinstated March 4, 1940.

Strong, Sidney Davis, Assoc. M., reinstated Feb. 26, 1940.

Resignations

Burge, Eugene Field, Jun., resigned March 1, 1940.

Cooke, Charles Prentice, M., resigned March 1, 1940.

Foster, Harry Llewellyn, Assoc. M., resigned March 1, 1940.

Lewis, Ralph Webster, Assoc. M., resigned March 1, 1940.

Roelke, Paul Lewis, Jun., resigned March 1, 1940.

Thompson, Fred Lawrence, M., resigned March 1, 1940.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

April 1, 1940 Number 4

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in Civil Engineering *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

Minimum Requirements for Admission

Grade	General Requirement	Age	Length of Active Practice	Responsible Charge of Work
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

Applying for Member

Ackerman, Adolph John (Assoc. M.), Pittsburgh, Pa. (Age 38) (Claims RCA 6.9 RCM 7.8) Oct. 1937 to date with Dravo Corporation as Development Engr. and Director of Eng.; previously Head Constr. Plant Engr., TVA, Knoxville, Tenn.

Aslakson, Carl Ingman, Bethesda, Md. (Age 43) (Claims RC 7.9 D 3.6) Oct. 1923 to date with U.S. Coast and Geodetic Survey as Deck Officer, Observer, Jun. Hydrographic and Geodetic Engr., and (since July 1935) Hydrographic and Geodetic Engr.

Barrett, Eugene Vincent (Assoc. M.), Caracas, Venezuela. (Age 38) (Claims RCM 6.0) Dec. 1936 to date Chf., Materials Testing Laboratory, Ministry of Public Works, Venezuela; previously Jun. Eng. Supervisor, Materials Inspection and Testing Div., WPA, New York City.

Berry, Charles Valentine, Kalamazoo, Mich. (Age 39) (Claims RCM 17.0) 1928 to date Gen. Mgr. and Chf. Engr., Kalamazoo Haydite Tile Co., manufacturing, selling, and designing concrete units.

Brimble, George Clifford, Santurce, Puerto Rico. (Age 49) (Claims RC 16.1 D 9.7) Jan. 1936 to date Associate Civ. Engr., U.S. Navy Dept., Bureau of Yards and Docks; previously Designing Engr. (Grade IV), California Dept. of Public Works, Bridge Div.

Brinckerhoff, Henry Morton, New York City. (Age 71) (Claims RCM 46.0) 1906 to date member of firm, Parsons, Klapp, Brinckerhoff & Douglas (formerly Wm. Barclay, Parsons and Eugene Klapp), at present Senior Partner, on consulting work, design, reports, etc.

Brown, Andrew Joseph, Chicago, Ill. (Age 46) (Claims RCA 6.5 RCM 5.9) Jan. 1939 to date

Asst. Structural Designer, Dept. of Subways and Superhighways; previously Structural Designer, Chas. DeLeuw & Co.; Chf. Engr., S. F. Neidam, Structural Engr.; Structural Designer, successively with Strauss Bascule Bridge Co., F. W. Seidensticker, Structural Engr., A. S. Alschuler, Archt., Graham-Anderson-Probst & White, Archts., and Strauss Eng. Corporation, all of Chicago, Ill.

BRUTON, PHILIP GILSTRAP (Assoc. M.), Buffalo, N.Y. (Age 48) (Claims RCA 4.6 RCM 16.2) Aug. 1917 to date with U. S. Army, as 2d Lieut., 1st Lieut., Capt., Major, etc., since Oct. 1938 being Dist. Engr., Buffalo Engr. Dist.

BURDICK, ROY DAYTON, Morgantown, W.Va. (Age 47) (Claims RCA 2.3 RCM 18.7) June 1916 to date with U.S. Army, successively with Ohio National Guard Engrs. (later 112th Engrs.), Mexican Border and Training Camp Service, Capt., Coast Artillery Corps, and (since July 1920) Capt. and Major, Corps of Engrs.

BYERS, EDWIN WILLIAM, Chicago, Ill. (Age 43) (Claims RC 16.1 D 14.4) Oct. 1934 to date with Montgomery Ward & Co., as Chf. Specification Writer, Constr. and Equipment Dept., also since Oct. 1936 Section Head, Archt. Unit, and (since June 1937) Asst. Archt.

CANALS, CESAR SOCORRO (Assoc. M.), Mollendo, Peru. (Age 37) (Claims RC 10.0 D 1.5) Nov. 1929 to date Engr., Frederick Snare Corporation, New York City.

CARMAN, SIMON PETER, Binghamton, N.Y. (Age 40) (Claims RCA 5.2 RCM 7.7) July 1934 to date Asst. and Deputy City Engr., Bureau of Eng., Binghamton, N.Y.

CARR, JOSEPH ARTHUR, Ridgewood, N.J. (Age 50) (Claims RCA 2.7 RCM 20.8) June 1921 to date Engr. and Supt., Ridgewood Water Dept.

DEVAUL, WILLARD ROGERS (Assoc. M.), Greenwich, Conn. (Age 41) (Claims RCA 5.2 RCM 13.0) March 1924 to date with S. E. Minor & Co., Inc., Civ. Engrs., as Highway Engr., Vice-Pres., and since Jan. 1940 Pres.

DOAK, JOHN (Assoc. M.), Urbana, Ill. (Age 38) (Claims RCM 15.0) 1923 to date with Univ. of Illinois as Draftsman, Inspector, Asst. Supt. of Bldg. Constr., Supt. of Bldg. Constr., and (since 1936) Supt. of Bldgs.

DOLL, THEODORE FRANCIS, Kansas City, Mo. (Age 45) (Claims RCA 5.1 RCM 7.9) June 1938 to date Designer, Ash-Howard-Needles & Tammen; previously in private practice; Draftsman, Chicago, Milwaukee, St. Paul & Pacific R.R., Chicago, Ill.; Bridge Draftsman and Asst. Engr., Atchison, Topeka & Santa Fe R.R., Chicago, Ill.

DYE, EDWARD RANDOLPH, Bozeman, Mont. (Age 38) (Claims RC 13.3 D 11.0) Sept. 1929 to June 1935 Asst. Prof., and Sept. 1935 to date Associate Prof., of Civ. Eng., Montana State Coll.

ELDER, CLAYBURN COMBES (Assoc. M.), Los Angeles, Calif. (Age 44) (Claims RCA 4.1 RCM 12.1) May 1930 to date with Metropolitan Water Dist. of Southern California as Hydrographic Engr. (Senior Engr.) on Colorado River Aqueduct investigations.

FRY, BERWYN JOSEPH, Chicago, Ill. (Age 37) (Claims RCA 3.5 RCM 10.5) Dec. 1931 to date Chf. Engr., E. J. Albrecht Co.

GARDNER, LYLE BURDETTE, Johnstown, Pa. (Age 36) (Claims RCA 3.5 RCM 6.9) Nov. 1927 to date with E. J. Albrecht Co., Engrs.-Contrs., Chicago, Ill., as Asst. Supt., Supt., and (since April 1933) Gen. Supt.

GEBHARDT, JOHN FREDERICK WILLIAM (Assoc. M.), Indianapolis, Ind. (Age 55) (Claims RC 24.4 D 5.0) Nov. 1935 to date Constr. Engr. and Engr. Inspector, Land Utilization Program (under RA and later FSA); previously Superv. Engr., New Jersey Geodetic Control Survey.

GRIME, EDWIN MORRELL, St. Paul, Minn. (Age 63) (Claims RCA 7.1 RCM 31.6) June 1907 to Jan. 1908 and June 1908 to date with Northern Pacific Ry., as Bldg. Constr. Inspector, Asst. Engr., Supervisor of Bridges and Bldgs., and (since Aug. 1925) Engr. of Water Service.

HAYES, CHARLES EDWARD, East Lansing, Mich. (Age 57) (Claims RCA 1.8 RCM 7.6) Dec. 1933 to date with Michigan State Highway Dept., as Project Engr., Dist. Engr., Asst. to Deputy Commrs., and (since July 1937) WPA Engr. and Engr.-in-Chg., FAS Program.

HERSUM, LEROY MAXWELL, Boston, Mass. (Age 41) (Claims RCM 10.6) Oct. to Dec. 1937 Cons. Engr. on buildings, and Jan. 1940 to date Structural Engr., Univ. of New Hampshire; in the interim Designing Engr. for various firms, and Cons. Engr., Massachusetts Dept. of Public Works.

HOMER, LANGLEY STODDARD (Assoc. M.), Boston, Mass. (Age 49) (Claims RCA 3.5 RCM 11.0) 1920 to date Supt. of Constr., Turner Constr. Co.

LAWSON, HEATHCOTE WILLIAM, Bethlehem, Pa. (Age 50) (Claims RCA 3.0 RCM 19.9) April 1931 to date Engr., Bethlehem (Pa.) Steel Corporation, fabricated steel construction.

LEWIS, EDWARD ROWLAND, Detroit, Mich. (Age 70) (Claims RCA 2.0 RCM 37.6) At present retired; Aug. 1906 to June 1912 Div. Engr. of Maintenance and March 1921–Dec. 1939 Office and Prin. Asst. Engr., Michigan Central R.R.

LINDBERG, HARRY EMIL, Pittsburgh, Pa. (Age 42) (Claims RCA 6.3 RCM 12.8) July 1919 to date with Pittsburgh-Des Moines Steel Co., as Draftsman, Designer, and (since May 1927) Asst. Chf. Engr.

MAGUIRE, CHARLES AUGUSTINE (Assoc. M.), Providence, R.I. (Age 52) (Claims RCA 18.0 RCM 7.0) 1938 to date Cons. Engr.; previously Commr. of Public Works, Providence.

MAYO, ROBERT SPRAGUE, Lancaster, Pa. (Age 39) (Claims RCA 5.7 RCM 8.6) July 1937 to date in private practice, designing and fabricating special equipment and machinery for construction, etc.; previously Engr., Ransome Concrete Machinery Co., Dunellen, N.J.; Engr., Steel Form Dept., Blaw-Knox Co., Blawnox, Pa.

PARK, RICHARD, Mobile, Ala. (Age 56) (Claims RCA 3.0 RCM 23.4) 1907 to date with U.S. Engrs. as Asst. to U.S. Dist. Engr., Asst. Dept. Engr., Commanding Officer, Executive Officer, Constr. Engr., Chf. of Supply Sec., etc., and (since March 1936) Dist. Engr.

TAUSSIG, JOHN WRIGHT (Assoc. M.), New York City. (Age 52) (Claims RCA 5.5 RCM 25.7) Sept. 1908 to date with Raymond Concrete Pile Co., as Asst. Supt., Supt., Gen. Supt., (Chicago Dist.), Dist. Mgr., Asst. Gen. Mgr., and (since Jan. 1926) Vice-Pres. and Director.

THORPE, FREDERICK THOMAS, JR., Philadelphia, Pa. (Age 48) (Claims RCA 9.0 RCM 11.0) 1908 to date with Bureau of Surveys, City of Philadelphia, as Chainman, Rodman, Transitman, Second Asst. Surveyor, First Asst. Surveyor, Prin. Asst. Surveyor, and (since 1928) Surveyor and Regulator.

WERNER, PER WILHELM (Assoc. M.), Stockholm, Sweden. (Age 46) (Claims RCA 7.8 RCM 9.6) Dec. 1925 to date with A. B. Vattenbyggnadsbyran, Cons. Engrs., as Cons. and Designing Engr.

WILSON, MAYBIN HOMES, Morgantown, W.Va. (Age 48) (Claims RCA 3.0 RCM 23.0) Dec. 1917 to date with U.S. Army, 1st Lieut., Capt. and Major, Corps of Engrs.

ZIMMERMAN, OSCAR AMBROSE (Assoc. M.), Kansas City, Mo. (Age 58) (Claims RCM 28.7) Aug. 1939 to date Field Engr., Massman Constr. Co.; previously with Kansas City (Mo.) Bridge Co., as Chf. Engr., Vice-Pres., and Gen. Mgr.

APPLYING FOR ASSOCIATE MEMBER

BARBEE, EDWIN WALLACE (Junior), San Francisco, Calif. (Age 32) (Claims RCA 1.3) Aug. 1937 to date Water Purification Engr., Purification Div., San Francisco Water Dept.; previously Field Engr., Wallace & Tiernan Sales Corporation.

BEST, WALTER EUGENE (Junior), Vicksburg, Miss. (Age 33) (Claims RCA 6.1 RCM 3.7) Feb. 1930 to date with U.S. Engr. Office as Surveyman, Jun. Engr., and (since July 1936) Asst. Engr. and Associate Engr.

BRESCIA, RALPH NICHOLAS, New York City. (Age 28) (Claims RCA 2.0) Feb. 1936 to date Jun. Engr. and Senior Computer, War Dept., U.S. Army (WPA), Ft. Jay, Governors Island; previously Transitman, Parks Dept. (WPA), New York City.

BROWNE, HAROLD GEORGE (Junior), Los Angeles, Calif. (Age 32) (Claims RCA 5.7) Nov. 1935 to date with U.S. Engr. Dept., as Asst. Engr., and (since Aug. 1937) Associate Engr.; previously Rodman and Jun. Engr., Metropolitan Water Dist. of Southern California.

CARLSON, FRANK BOWERS (Junior), Alhambra, Calif. (Age 32) (Claims RCA 4.6) Nov. 1935 to date with U.S. Engrs., as Senior Eng. Aide, Asst. to Engr., and (since May 1938) Associate Engr., Structural Design Subsection of Dam Design Sec.; previously Jun. Engr., U.S. Dept. of Agriculture, Bureau of Biological Survey.

CHADWICK, WILLIAM JACOB, Racine, Wis. (Age 35) (Claims RCA 11.7) June 1927 to date with City of Racine, since Aug. 1928 as Asst. City Engr.

CONGDON, WILLIAM HOLMES, Phoenix, Ariz. (Age 29) (Claims RCA 3.1 RCM 0.8) April 1936 to date with CCC, on ID Projects as Jun. Engr., Prin. Eng. Aide, and (since June 1939) Asst. Engr., Dist. Office; previously Rodman and Instrumentman, Chicago, Burlington & Quincy R.R.; Trail Locator, Pine Ridge Indian Reservation.

DARBAKER, ARTHUR KINNARD, Clairton, Pa. (Age 32) (Claims RCA 5.0) March 1935 to date Civ. Engr., Carnegie-Illinois Steel Corporation; previously Inspector, Pennsylvania Highway Dept. Pittsburgh, Pa.

DEARDORFF, HERBERT HADLEY, Hayward, Calif. (Age 31) (Claims RCA 6.0) Aug. 1930 to date with California Div. of Highways as Senior Eng. Field Aide, Jun. Highway Engr., Jun. Bridge Engr., Asst. Bridge Engr., and (since Dec. 1936) Jun. Highway Engr., Dist. IV.

DEBARDELEBEN, JAMES MITCHELL, Little Rock, Ark. (Age 33) (Claims RCA 1.1 RCM 4.0) Oct. 1930 to date Jun. Highway Engr., Asst. Highway Engr., and (since June 1936) Associate Highway Engr., U.S. Bureau of Public Roads (now PRA).

DHAMANI, PESSUMAL NARUMAL, Khairpur Mir's, Sind, India. (Age 52) (Claims RCA 13.6) Jan. 1915 to date with Khairpur State as Overseer, Sub-Divisional Officer, State Engr., Supervisor, in Rohri Canal No. 1 Div., Personal Asst. to Public Works Member, Executive Council, and (since June 1933) Asst. Engr., Seepage and Bldgs. Sub-Div.

DIETZ, OLEN ADOLPH, Ancon, Canal Zone. (Age 32) (Claims RCA 2.5) Oct. 1939 to date Jun. Engr., Municipal Eng. Dept.; previously Asst. Engr. and Inspector on construction of Barracks, Constr. Q.M., Fort Sill, Okla.; Chf. of Party, City of Memphis, Tenn., L. & W. Div.; Engr., S. & W. Cons. Co., Memphis, Tenn.; Engr. Technician, Tennessee Forestry Service.

DORRANCE, WILLIAM TULLY, JR. (Junior), Glastonbury, Conn. (Age 32) (Claims RCA 4.6) July 1938 to date with Connecticut Highway Dept. as Senior Draftsman and (since July 1939) Senior Eng. Aide; previously Steam Fitters Helper, Gibbs and Hill, Inc.; Office Engr. of Catenary, The Arundel Corporation; Engr., The Tredennick-Billings Co., Boston, Mass.; Sales Engr. and Estimator, The Rock Wool Insulation Corporation.

FISCHER, PHILIP CONRAD (Junior), New York City. (Age 32) (Claims RCA 1.3) Dec. 1931 to date with New York City Dept. of Water Supply, Gas & Elec., as Draftsman, Electrolysis Div., and (since Dec. 1938) Transitman, Manhattan Constr. Div.

FLANAGAN, JAMES FRANCIS, Graeagle, Calif. (Age 43) (Claims RCA 13.5) July 1920 to Aug. 1922, summers 1923–1924 (while student), and Oct. 1926 to date with California Fruit Exchange, Lumber Dept., as Instrumentman, Draftsman, and (since Oct. 1926) Engr. in charge of all civil engineering work.

GALLIMORE, CLARENCE LEROY, Cincinnati, Ohio. (Age 35) (Claims RCA 8.1 RCM 2.9) Jan. 1929 to date with U.S. Engr. Office as Surveyman, Asst. Engr., Asst. Res. Engr., Associate Engr., and (since June 1937) Engr.

GILES, JOHN HENRY LATHAM (Junior), Elmwood, Conn. (Age 32) (Claims RCA 2.5) July 1929 to date with Connecticut State Dept. of Health, Hartford, Conn., as Asst. San. Engr., and (since Sept. 1936) Senior San. Engr.

GINGELL, HOWARD A., Long Island City, N.Y. (Age 42) (Claims RCA 11.8 RCM 5.2) July 1938 to date with Metropolitan Housing as Engr. Designer, Board of Design, and since Aug. 1939 Asst. Engr. at Starrett Bros. & Eken, Inc.; previously Engr., CWA, TERA, and WPA.

GUDEN, RICHARD MORTIMER, Lynbrook, N.Y. (Age 28) (Claims RCA 2.4) 1936 to 1937, July 1937 to Feb. 1938 and Dec. 1939 to date with U.S. Engrs. as Surveyman and Inspector; previously Rodman, Chainman, Transitman, Chf. of Party, Asst. Field Engr., and Field Engr., W. H. Gahagan, Contr. Engr. (later W. H. Gahagan Constr. Co.), Brooklyn, N.Y.

HAAS, EDWARD THOMPSON (Junior), San Francisco, Calif. (Age 32) (Claims RCA 4.0) Oct. 1935 to date Pres., Vermillion (S.Dak.) Natural Gas Co.; also, since Jan. 1937 Vice-Pres. and Gen. Mgr., William Bros. & Haas, Inc., Gen. Contrs.; since July 1939 Pres., Hawarden (Iowa) Natural Gas Co.; previously Field Engr., Haas, Doughty & Jones.

HEFELFINGER, CHARLES MOSES (Junior), Lakewood, N.J. (Claims RCA 4.4 RCM 4.0) Aug. 1939 to date Gen. Contr.; previously with Sherman & Sleeper, Cons. Engrs., Camden, N.J., C. J. Kupper, Cons. Engr., Bound Brook, N.J., Harry M. Herbert, Civ. Engr., and Herbert Realty & Improvement Co., Seaside Heights, N.J., Forestry Supervisory Foreman, Dept. of Interior, State Park No. 8, New Jersey.

HODGES, THOMAS LAWRENCE (Junior), Greensboro, N.C. (Age 32) (Claims RCA 6.2) Jan.


INSTALLATION COSTS A simple, easily operated chain puller is the only tool needed for assembly of Simplex Couplings. Unskilled crews can lay Transite rapidly and economically, as fast as the trench is opened. Job shown here is in Washington State.
HANDLING COSTS Transite's long, light lengths keep handling costs low. Smaller trucks carry more footage; loading and unloading is faster, easier. More than 16,000 feet of Transite are used on this Pennsylvania line.
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CORROSIVE SOILS Corrosion has little effect on Transite's asbestos-cement structure. Even in unusually acid or alkaline soils, it assures minimum upkeep costs. Above line is part of a 9,000-foot Texas system.
DEEP TRENCHES In deep trenches like the above, Transite's strength and durability protect against breakage. Over ten miles of Transite are used on this California system.
WIDE SWEEPS Flexibility of Simplex Couplings permits wide sweeps to be made with straight lengths of Transite. No special fittings are needed, joints stay tight. Above job in Maine.
ELECTROLYSIS Electric current from power or street-railway lines cannot damage Transite. It is inorganic, immune to electrolysis. This system is in Winnipeg, Canada.
JOHNS-MANVILLE JM PRODUCTS
Johns-Manville TRANSITE

1939 to date Sales Engr., American Bitumels Co., Baltimore, Md.; previously Sales Engr. and Designer, Dave Steel Co., Asheville; Asst. Plant Engr., Stonecutter Mills Co., Spindale, N.C.; Jun. Civ. Engr., U.S. Forest Service, Asheville.

JACKSON, JAMES ALLEN (Junior), Indianapolis, Ind. (Age 27) (Claims RCA 1.8) Sept. 1937 to date Asst. Engr., Bureau of San. Eng., Indiana State Board of Health; previously Inspector, Indiana State Highway Comm.; Tech. Foreman, U.S. Forest Service, ECW, SCS.

KEIM, SAMUEL GEORGE (Junior), Santa Fe, N.Mex. (Age 31) (Claims RCA 5.2 RCM 0.3) April to Nov. 1937 and Sept. 1938 to date with National Park Service as Eng. Draftsman, Inspector, and (since Nov. 1938) Instrumentman; in the interim Prof. Engr. in private practice and Asst. County Surveyor, Cotton County, Okla.; previously with Oklahoma Highway Dept. as Chainman, Rodman, Inspector, Instrumentman acting as Asst. to Res. Engr.

KING, WILLIAM CECIL (Junior), Pendleton, Ore. (Age 32) (Claims RCA 1.2) Feb. 1939 to date Asst. Hydr. Engr., Bureau of Agricultural Economics, U.S. Dept. of Agriculture; previously with Chicago, Milwaukee, St. Paul & Pacific R.R. as Rodman, Asst. Instrumentman, etc.

KNOX, CHARLES ESHELBY, Boston, Mass. (Age 33) (Claims RC 9.7) June 1928 to date with U.S. Geological Survey as Jun. Engr., Asst. Engr., and (since Sept. 1939) Associate Engr.

McDARGH, CHARLES DERBY, Indianapolis, Ind. (Age 37) (Claims RCA 9.5) April 1935 to date Dist. Engr., Dist. Supervisor (and Asst.), and Review Engr., Indiana ERA and WPA; previously Civ. Engr. with Charles Brossman, Cons. Engr., Indianapolis, Ind.

MIRGAIN, FRANK CHARLES, Highland Park, N.J. (Age 30) (Claims RC 2.0) Sept. 1931 to date with Rutgers Univ. as Research Asst. and graduate student in Civ. Eng., Asst. in, Instructor in, and (since July 1939) Asst. Prof. of, Civ. Eng.

NEWCOMB, NORMAN BEST (Junior), Weehawken, N.J. (Age 32) (Claims RCA 3.8) Jan. 1940 to date Draftsman with Phelps Dodge Corporation; also, autumn 1938 to date (evenings) teaching at Pratt Inst., Brooklyn, N.Y.; previously Jun. Engr., The Port of New York Authority, New York City.

ORBACZ, STANLEY EDWARD (Junior), Baltimore, Md. (Age 32) (Claims RCA 4.4) July 1938 to date with U.S. Engr. Office, Flood Control Div., as Eng. Draftsman (Civ.) and since July 1939 Jun. Engr. (Civ.); previously with New York Water Service Corporation, Woodhaven, N.Y., U.S. Coast and Geodetic Survey, Washington, D.C., Regents' Educational Inquiry, and New York State Dept. of Public Works, Div. of Canals, both of Albany, N.Y.

PASSALACQUA SANTIAGO, CARLOS MANUEL, Adjuntas, Puerto Rico. (Age 27) (Claims RCA 1.8) July 1936 to date with Garzas Hydro-Electric Project as Instrumentman, Jun. Civ. Engr., and (since April 1938) Asst. Civ. Engr. being Field Engr. on construction of plant; previously Instrumentman, Puerto Rico RA; Transitman, FERA Work Div.

PASTORIUS, JAMES WALLACE, Catasauqua, Pa. (Age 34) (Claims RC 6.0 D 7.5) Nov. 1936 to date Engr., Whitehall Cement Mfg. Co., Cementon, Pa.; previously Structural Designer, H. F. Everett & Associates, Archts., and Architectural Draftsman, Tilghman Moyer Co., Archts. & Engrs., both of Allentown; Structural Designer, Diebold Safe & Lock Co., Canton, Ohio.

PINYAN, RONALD AUGUST (Junior), Los Angeles, Calif. (Age 32) (Claims RCA 3.3) Dec. 1936 to Feb. 1938 and May 1938 to date Engr., Ford J. Twaits Co., Constr. Engrs.; in the interim Asst. to Milton E. Ramelli, Cons. Engr., Ventura, Calif.; previously Engr., Consolidated Steel Corporation; Engr. for Santa Anita Park.

POSS, ROBERT JOSEPH (Junior), Milwaukee, Wis. (Age 32) (Claims RCA 3.0) July 1930 to date with U.S. Engr. Office as Inspector, and (since April 1931) Jun. Engr.

POTTER, SEYMOUR AUSTIN, JR. (Junior), Hawthorne, N.J. (Age 32) (Claims RCA 1.6) Sept. 1930 to Feb. 1932 and Sept. 1933 to date with Erie R.R. Co., as Rodman, Levelman, Transitman, and since July 1939 Senior Transitman and Chf. of Curve Lining Corps, M. of W. Dept.

PRAUGHT, CLARENCE HAROLD (Junior), Los Angeles, Calif. (Age 32) (Claims RCA 1.0) Sept. 1939 to date Senior Eng. Draftsman, U.S. Engr. Office; previously Jun. Engr., U.S. Indian Service, Red Lake, Minn.

PRICE, HARRY STEELE, JR., Dayton, Ohio. (Age 29) (Claims RCA 3.5 RCM 4.2) June 1932 to date with Price Bros. Co., as Designing Engr., Layout Engr. and Supt. of Constr., and (since July 1937) Secy., and Cons. Engr.

RIDGE, SYLVESTER EDWIN (Junior), Highland, N.Y. (Age 32) (Claims RCA 7.1) Aug. 1931 to date Foreman, Supt., and Sales Engr., Bituminous Service Co., West Chester, Pa.

SMITH, VINCENT BASIL, New York City. (Age 38) (Claims RCA 11.6) July 1926 to date with McGraw-Hill Publishing Co., as Editorial Asst., Asst. Editor, and (since April 1934) Associate Editor.

SNOW, EDWIN JAMES (Junior), Rock Island, Ill. (Age 32) (Claims RCA 2.1) Oct. 1933 to date Jun. Civ. Engr., U.S. Engr. Corps, War Dept.

STEARNS, DONALD ELMER, Kingston, R.I. (Age 35) (Claims RC 4.1 D 0.2) Sept. 1932 to Sept. 1936 Instructor in, and Sept. 1936 to date Asst. Prof. of, Civ. Eng., Rhode Island State Coll.

SWIECH, PAUL CHARLES (Junior), Carnegie, Pa. (Age 32) (Claims RCA 3.9 RCM 0.6) Dec. 1939 to date Constr. Engr., Hold Constr. Co., Home Bldrs., Pittsburgh; previously Senior Chf. of Party, Pennsylvania Dept. of Highways, Pittsburgh; Instrumentman and Acting Chf. of Party, during RWD administration for City of Pittsburgh.

SYMONS, GEORGE EDGAR, Buffalo, N.Y. (Age 36) (Claims RC 6.2) April 1936 to date Chf. Chemist, Buffalo Sewer Authority; previously Asst. Engr., Greeley & Hansen, Engrs.; Consultant, Sullivan, Ill.

TANNER, BURFORD MAURICE (Junior), Glendora, Calif. (Age 32) (Claims RCA 7.5 RCM 0.8) Sept. 1938 to date Asst. Hydr. Engr., U.S. Forest Service; previously Asst. Hydr. Engr., Water Resources Div., California Dept. of Public Works, Sacramento, Calif.; Engr.-Draftsman, Shell Oil Co., San Francisco, Calif.; graduate student.

TAYLOR, LESLIE SEYMOUR, Sharpsville, Pa. (Age 33) (Claims RCA 2.8) Jan. 1939 to date Party Chf., U.S. Engr. Office, Pittsburgh, Pa.; previously at U.S. Naval Air Station, Lakehurst, N.J.; Res. Engr. of construction camp, Mene Grande Oil Co., C.A., Barcelona, Venezuela; Chf. of Party, New Jersey Geodetic Control Survey; Engr., U.S. Coast and Geodetic Survey.

THOMPSON, WILLIAM DONALD, Kansas City, Mo. (Age 44) (Claims RCA 6.0 RCM 6.0) March 1922 to date with Black & Veatch, Cons. Engrs., about 6 months in drafting room, and since Sept. 1922 on appraisal and valuation work.

VENARD, JOHN VICTOR (Junior), Syracuse, Kans. (Age 32) (Claims RCA 1.4) June 1928 to Feb. 1929, June 1929 to Feb. 1930, Feb. 1931 to Feb. 1932, and Feb. 1935 to date with Kansas Highway Comm., as Inspector, Jun. Draftsman, and Asst. Engr., Grade B, and (since Sept. 1938) Asst. Engr., Grade A.

WALLACE, KEITH KERNEY, (Junior), Honolulu, Hawaii. (Age 32) (Claims RCA 4.5) Oct. 1935 to date with Board of Water Supply, Honolulu, as Jun. Civ. Engr., and (since Jan. 1939) Asst. Civ. Engr.; previously with Dept. of Public Works, Bureau of Plans, City and County of Honolulu.

WHITE, MERIT PENNIMAN (Junior), Chicago, Ill. (Age 31) (Claims RCA 2.8) Sept. 1939 to date Asst. Prof. of Civ. Eng., Armour Inst. of Technology; previously Research Associate, Graduate School of Eng., Harvard Univ., and Research Asst., California Inst. of Technology; Jun. Conservationist (Engr.), and Asst. Engr., Soil Conservation Service.

WHITEHEAD, RICHARD STANLEY (Junior), Sacramento, Calif. (Age 32) (Claims RCA 6.0) Oct. 1937 to date Engr., State Planning Board; previously Regional Engr., FSA, and Regional San. Engr., RA, San Francisco; Recorder, Observer, and Surveyor, U.S. Coast and Geodetic Survey.

WILEY, JOHN EDWARD, Cheyenne, Wyo. (Age 36) (Claims RCA 5.7 RCM 4.8) At present Engr.-Secy., Associated Gen. Constr. of Wyoming; previously Instrumentman, Asst. Engr., Draftsman, Asst. Engr. of Plans, Project and Traffic Engr., Wyoming State Highway Dept.; Mgr., Highway Planning Survey.

WILSON, WARREN ELVIN (Junior), Detroit, Mich. (Age 32) (Claims RCA 2.2) Sept. 1939 to date Asst. Prof. of Civ. Eng., Wayne Univ.; previously Asst. Prof. of Civ. Eng., Tulane Univ.; general engineering practice; Instructor in, and Asst. Prof. of, Civ. Eng., South Dakota State School of Mines.

APPLYING FOR JUNIOR

ABBOTT, LYLE ARNOLD, San Francisco, Calif. (Age 23) 1939 B.S. in Civ. Eng., Univ. of Calif.

AL-AWAR, ARIF MAHMUD, Berkeley, Calif. (Age 22) 1939 B.S. in Civ. Eng., Univ. of Mich.

BASZNER, RAYMOND WALSH, North Providence, R.I. (Age 31) (Claims RCA 0.8) Nov. 1938 to date with Charles A. Maguire and Associates, Providence, R.I., on plans, engineering computations, and drafting work; previously with City of Providence, R.I., Stone & Webster Eng. Corporation, Boston, Mass., Massachusetts State Highway Office, Worcester, Mass., and Board of Assessors, Northbridge, Mass.

DAVIES, ARVON LLOYD, Ann Arbor, Mich. (Age 28) June 1936 to date with Michigan State Highway Dept. as Research Asst., and (since Sept. 1938) Soil Testing Engr.; also, Sept. 1937 to date at Univ. of Michigan, successively as Teaching Fellow, Research Asst., and Instructor.

DE JONGE, ROBERT RICHARD, Chicago, Ill. (Age 25) 1940 B.S. in C.E., Univ. of Ill.

HALFF, ALBERT HENRY, Kingsville, Tex. (Age 24) (Claims RCA 1.7) Dec. 1939 to date Instructor, Texas Agricultural and Industrial Coll.; previously Asst. Office Engr., Koch & Fowler, Cons. Engrs., Dallas, Tex.

HALVORSON, SIGURD, Portland, Ore. (Age 29) (Claims RC 1.3 D 0.5) Jan. 1940 to date Senior Draftsman (Topographic), U.S. Engrs.; previously Instrumentman and Asst. Engr., North Dakota Water Conservation Comm.; Rodman, Instrumentman, Structural Draftsman, and Draftsman, North Dakota Highway Dept.

HENDERSON, KNOX BERRY, Bartlesville, Okla. (Age 23) 1939 B.S. in C.E., Okla. A. & M. Coll.; June 1939 to date Apprentice Engr., Design Div., Gen. Eng. Dept., Phillips Petroleum Corporation.

HYMAN, ERNEST ROY, Trinidad, B.W.I. (Age 24) 1939 S.M., Mass. Inst. Tech., B.Sc., Univ. of Manitoba; Jan. 1940 to date Asst. Engr., Trinidad Leaseholds Ltd.

JUNG, JOSEPH WILLIAM, Glendale, N.Y. (Age 21) 1940 B.C.E., Coll. of City of N.Y.

KARLEN, ROY EDWIN, Louisville, Ky. (Age 29) (Claims RCA 1.3) June 1934 to date with U.S. Engr. Dept. as Inspector, Eng. Aide, Senior Eng. Aide, and (since Dec. 1938) Asst. Engr., Design Sec., Flood-Control Dept.

KLINER, WALTER JOSEPH FRANK, Chicago, Ill. (Age 27) 1940 B.S. in C.E., Univ. of Ill.

LEVITAN, PHILIP WOLF, New York City. (Age 23) 1937 B.S., and 1940 B.C.E., Coll. of City of N.Y.; at present with B. W. Levitan, Archt.

LYON, GEORGE BERNARD, Champaign, Ill. (Age 22) 1940 B.S. in C.E., Univ. of Ill.

McKINNEY, JAMES ROBERT, Cleveland, Ohio. (Age 26) Sept. 1939 to date Graduate Asst. in Civ. Eng., Case School of Applied Science; previously Jun. Engr. Inspector, PWA; Jun. Hydr. Engr., Hydr. Data Div., TVA.

MADSEN, RUSSELL HYRUM, Provo, Utah. (Age 26) 1937 B.S., Univ. of Utah; June 1937 to date with U.S. Bureau of Reclamation as Rodman, Asst. Eng. Draftsman, and (since Dec. 1939) Jun. Engr.

MASON, TROXELL OLIN, Cairo, W.Va. (Age 29) 1940 B.S. in C.E., W.Va. Univ.

MAUEL, EDWARD, Chicago, Ill. (Age 21) 1940 B.S. in C.E., Univ. of Ill.

NICHIPORUK, STEVEN WALTER, Chicago, Ill. (Age 23) 1940 B.S. in C.E., Univ. of Ill.

PETERSON, CARLYLE WILHELM, Ames, Iowa. (Age 22) 1939 B.S. in Arch Eng., Iowa State Coll.; Sept. 1939 to date Instructor, Iowa State Coll.

POKRAJAC, NICK, East Moline, Ill. (Age 24) 1940 B.S. in C.E., Univ. of Ill.

PURDIE, DAVID JAMES, JR., Harrisburg, Pa. (Age 22) 1938 B.S. in Eng., Brown Univ.; Dec. 1938 to date Jun. Draftsman, Pennsylvania Turnpike Comm.

ROSS, JOHN FRANCIS, Midland, Tex. (Age 28) (Claims RCA 0.5) April 1937 to date Chainman, Head Chainman, and Jun. Civ. Engr., Humble Oil & Refining Co.; previously Aero Cartographer, U.S. Army Engr. Corps, Panama.

SCHECHET, MANUEL MARTIN, New York City. (Age 21) 1940 B.C.E., Coll. of City of N.Y.

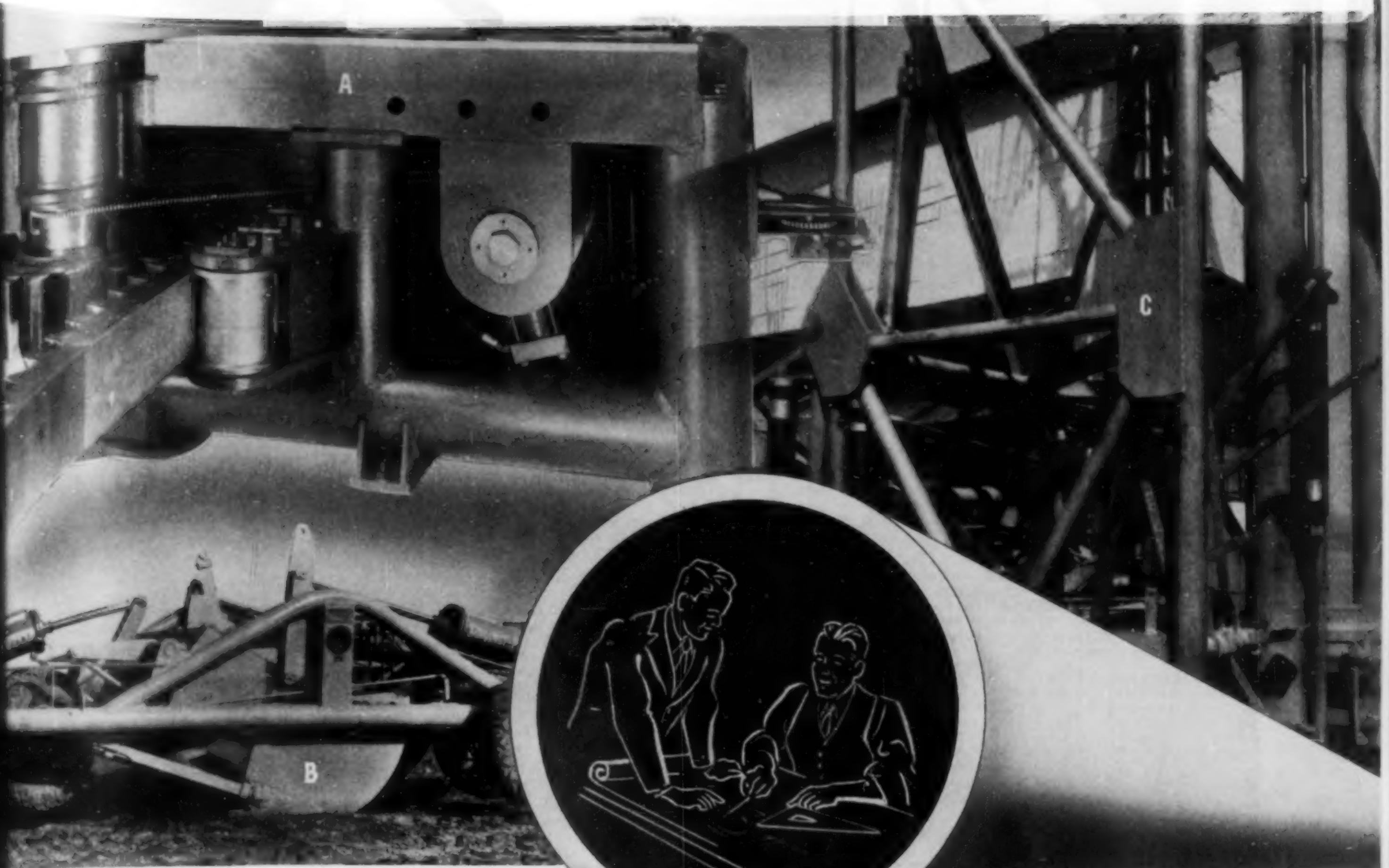
SIEGELMAN, BERNARD HERMAN, Columbus, Ohio. (Age 20) 1939 B.C.E., Ohio State Univ.

STRASSER, WILLIAM CONRAD, St. Louis, Mo. (Age 23) 1940 B.S. in Eng., Univ. of Mich.

THOMAS, RICHARD GLEN, Mt. Auburn, Ill. (Age 24) 1940 B.S. in C.E., Univ. of Ill.

WIEDEMAN, ALBERT FRED, Peoria, Ill. (Age 26) 1940 B.S. in C.E., Univ. of Ill.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.



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Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 132 of the 1940 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

Construction

Foundation Construction Engineer; Assoc. M. Am. Soc. C.E.; graduate; registered New York State; 27 years experience with contractor and owner as engineer and executive on construction of spread footing, pile, caisson, and rock foundations for industrial plants and public works. Desires position with contractor or engineer. Will go anywhere. Immediately available. C-663.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 39; technical graduate; registered state of Colorado. Wide experience in tunnel construction, rolled earthfill dams, concrete dams, canals and waterways, administration, investigations, reports, and estimates. Municipal and general engineering fields. Wishes position with engineer, architect, or contractor. C-672.

Civil Engineer; Assoc. M. Am. Soc. C.E.; technical graduate; licensed; 20 years experience in design, construction, supervision of technical personnel, and design of large power and irrigation projects; 10 years engineering field experience in heavy construction, also administration and estimating; open for immediate engagement any place. C-674.

Civil Engineer; Assoc. M. Am. Soc. C.E.; graduate; 35; 4 years experience in structural research; 2 years highway construction and location; 2 years water works, sewers, and sewage treatment; 2 years building construction; 1 year concrete research; 2 years teaching in Eastern university. C-675.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 34; technical school graduate; trained at Purdue University and Polytechnic Institute of Brooklyn; graduate of Battery Officers' course, Coast Artillery School; formerly engineer-in-charge of layout of large state park; desires to enter city planning field in which he has had some experience; at present with federal government on flood control work. C-676.

Design

Civil Engineer; Assoc. M. Am. Soc. C.E.; graduate; 38; 15 years experience on design and construction of dams and waterworks, field and office. Careful, accurate designer. Experienced in analysis and design of indeterminate structures. Now employed. C-666-294-Chicago.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 12 years experience, highways, construction, photogrammetric surveys, hydraulics. Now with firm of municipal engineers. Wishes connection leading toward broader experience in structures and design or in hydraulics. C-671.

Executive

Municipal and Construction Engineer; Assoc. M. Am. Soc. C.E.; 39; married; registered California; 16 years experience in general municipal and highway planning and utility construction, including sewers, water distribution systems, streets, and railways; 6 years devoted to construction of buildings, schools, and churches with much training in reinforced concrete. Location preferred, Southern California. C-662-402-A-2-San Francisco.

Materials and Concrete Engineer; M. Am. Soc. C.E.; 20 years experience in road building and other heavy construction. Charge of testing laboratories. Especially qualified in concrete design and control. Field engineer supervising mixing and placing on large scale. Extended experience with liquid asphalts, stabilization, hot mixtures. Published technical papers on aggregates, asphalt surfacing, and other subjects. C-664.

Junior

Engineer's Assistant; Student Chapter member; 27; married; night school student at Brooklyn Polytechnic Institute; 3 years construction and topographical surveying; 2 years topographical drafting; 1 year mosquito-control planning and inspecting; 1 year laboratory testing of gypsum products. Location immaterial. Now employed. C-679.

Civil Engineer; Jun. Am. Soc. C.E.; 33; married; B.S.C.E., 1933; 3 years office and field experience in the design and construction of open-ditch drainage systems; 1 year appraisal and valuation work; 1 year office engineer in regional office of Public Works Administration. Available immediately; location immaterial. C-661.

Civil Engineer; Jun. Am. Soc. C.E.; 27; single; C.E., Rensselaer Polytechnic Institute; Sigma Xi; 3 years continuous construction experience on bridges, parkways, and playgrounds; duties chiefly in charge of surveying, preparing estimates, and some inspection. Now employed. Desires design or research experience. Free to travel. C-665.

Civil Engineer; Jun. Am. Soc. C.E.; 21; single; B.E. in C.E., Yale University, 1939; 8 months engineering assistant to professional civil engineer and surveyor doing town planning, private development, and boundary survey work. Desires work in construction or design. Location immaterial. Available immediately. C-667.

Civil Engineer; Jun. Am. Soc. C.E.; member of four other national organizations; 31; single; B.S.C.E., University of Idaho, 1933; 4 years experience with levels, triangulation, and plane-table. Desires permanent position in Western states, not all field work, with opportunity for advancement. Available upon proper notice to employer. C-669.

Civil Engineer; Jun. Am. Soc. C.E.; 26; B.S. and M.S. degrees, with specialization in structures; 6 months experience as supervisor for alteration work; 1 year as estimator, and 5 months as junior designer in reinforced concrete. Salary and location secondary to good opportunity. C-677.

Civil Engineer; Jun. Am. Soc. C.E.; 26; married; B.S.C.E., 1935; 5 years varied experience—U.S.B.R. project; civil engineering instructor; oil field surveys, estimates, and construction. Qualification, Grade 2 (Civil Engineering, February 1939). Desires opportunity for advancement to responsible position. Location anywhere. Available two weeks' notice. C-678-402-A-6-San Francisco.

Research

Engineer; Assoc. M. Am. Soc. C.E.; technical graduate; experienced in construction and materials testing, particularly soil mechanics as applied to dam construction. Interested in research work in soil mechanics or in its applications to dam, highway, and foundation work. Work in foreign countries acceptable. C-670.

Teaching

Structural-Mechanical Engineer; Jun. Am. Soc. C.E.; 26; B.S., "With High Honors," M.S., Cornell University, specializing in hydraulics and structural engineering; 2 years experience in structural design, including industrial buildings, highway bridges, oil refinery stills, etc. $1^1/_2$ years experience in machine design; desires position as instructor in college or university. C-660.

Assistant Professor; Jun. Am. Soc. C.E.; 31; B.S.; M.S.C.E.; C.E.; 10 years teaching varied program, including practically every civil engineering subject; $2^1/_4$ years practical experience in surveying, construction, highways, drafting; some minor publications. C-668.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 122 of the Year Book for 1940. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

(The) Alloys of Iron and Chromium, Vol. 2. High-Chromium Alloys. By A. B. Kinzel and R. Franks. Published for The Engineering Foundation by McGraw-Hill Book Co. (New York), 1940. 559 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $6.

This is the final part of the review and summary of important published and available unpublished data on the alloys of iron and chromium prepared under the auspices of the Iron Alloys Committee of the Engineering Foundation. This section deals with alloys containing more than 10% of chromium, which include the corrosion-resistant and heat-resistant steels. The monograph affords a critical summary of research upon these alloys. A bibliography of over five hundred references of importance is included.

American Road Builders' Association, Proceedings, 36th Annual Convention, March 7–10, 1939, San Francisco. Edited by C. M. Upham and others. Washington, American Road Builders' Association (National Press Bldg.), 1939. 618 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $10.

The numerous committee reports and individual papers included in this volume embrace practically all phases of highway design, construction, finance, and legislation. The emphasis is on new methods and developments, with particular reference to soil stabilization.

Catalogue of Topographic and Geologic Maps of Virginia. By J. K. Roberts and R. O. Bloomer. Richmond (Va.), The Dietz Press, 1939. 246 pp., 9 × 6 in., paper, $3.

This comprehensive list of maps having interest for the student of the geology of Virginia includes 970 maps, with information as to scale, size, contour intervals, geological data, etc. The arrangement is chronological, covering the years 1782–1939. There is a brief essay on the history of Virginia maps, a list of geologic formations used in Virginia, Rogers' table of geologic formations of Virginia and West Virginia, and subject and author indexes.

(The) Complete Welder, Dealing with Up-to-Date Methods of Gas and Electric Welding. 3 Vols. Vol. 1. Non-Electrical Methods, Design and Testing. 464 pp. Vol. 2. Electric Arc Welding. 432 pp. Vol. 3. Resistance Welding. 432 pp. London, W.C. 2, George Newnes, Ltd., 1939. Illus., diagrs., charts, tables, $9^1/_2$ × 6 in., cloth, £3 for 3 volumes.

The three volumes of this set are composed of articles contributed by specialists, which are intended to cover every aspect of welding. The operation of equipment for all kinds of welding is explained, types of actual equipment on the market are described, and work under varying conditions and with different metals is discussed. All phases of the text are illustrated profusely with photographs and diagrams. Volume III contains a classified key and an alphabetical index to the whole work, and 28 miscellaneous data sheets are contained in a separate cover.

Construction Estimates and Costs. By H. E. Pulver. McGraw-Hill Book Co., New York and London, 1940. 653 pp., charts, tables, 9 × 6 in., cloth, $5.

Written for practical men, this book gives a thorough explanation of the best methods of estimating construction costs. Through the use of tables and diagrams which are comprehensive, accurate, and useful, the author gives both the time in hours required to do work and the amount of work done per hour. Many illustrative estimates have been included to show the practical application of the methods explained. Both the text and tables are based on current material costs.

(The) Construction of Roads and Pavements, 5 ed. By T. R. Agg. New York and London, McGraw-Hill Book Co., 1940. 483 pp., illus., diagrs., charts, tables, $9^1/_2$ × 6 in., cloth, $4.

This text is intended to be a "concise presentation of approved practice in the construction of roads and pavements and of the principles involved." Questions of administration, finance, plans, design, and surfacing are covered com-

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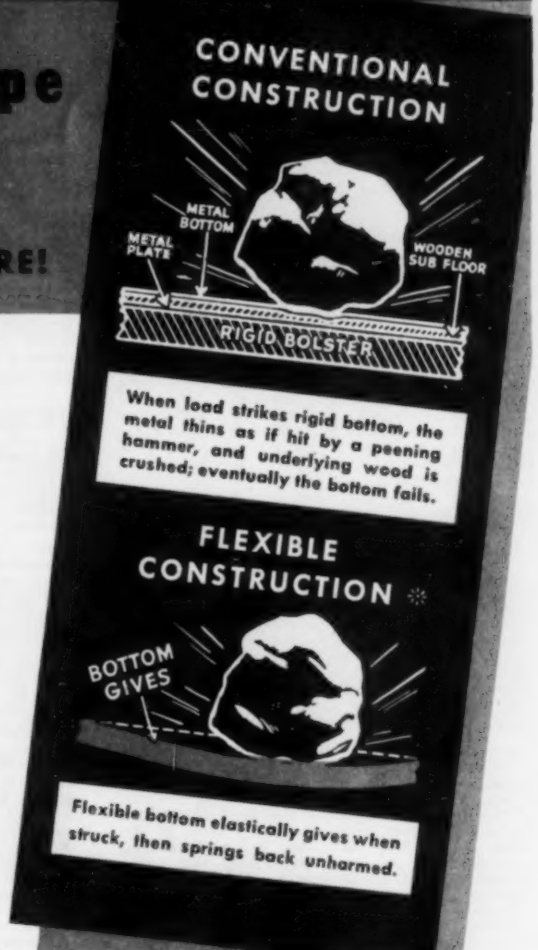
prehensively. The new edition is entirely re-

Flexible Bottom Dump Body, 10 Yard Heavy Duty, Constructed of Aluminum for Geo. M. Brewster & Son, by Veenema and Wiegers, Inc., Paterson, New Jersey.

A Revolutionary *New* Type of Dump Body!

IT TAKES MORE BECAUSE IT GIVES MORE!



Here is a dump body worth studying. It's designed to take more punishment; the diagrams show how built-in "give" makes it last longer. It's also designed for lightness, for extra payload capacity.

Aluminum helps combine all advantages. This type of body does not use conventional bolsters; the bottom is supported only by the sides of the cradle. The flexible bottom plate of this design must be thick in order to have the strength required for bearing the load. By using Alcoa Aluminum Alloys the plate is made thick and strong; yet it is light, and does not add needless weight.

In service one of these new bodies is saving enough money, by carrying more payload, to pay the extra cost of using Aluminum in 260 days. Another has been used for 20 months on a coal-stripping job noted for the havoc it plays with truck bodies; this unit is still in excellent condition.

Are you interested? Our engineers will be glad to tell you more about this particular type of body, which they developed.* ALUMINUM COMPANY OF AMERICA, 2127 Gulf Building, Pittsburgh, Pa.

Patent No. 2,140,590—issued December 20, 1938.

ALCOA ALUMINUM

prehensively. The new edition is entirely rewritten, and much new material is introduced.

CONTRIBUTIONS FROM THE PHYSICAL LABORATORIES OF HARVARD UNIVERSITY FOR THE YEAR 1938, Series II, Vol. 5. Cambridge (Mass.), Harvard University. Illus., diagrs., charts, tables, 11 × 8 in., cloth, $4.
The papers collected in these volumes previously appeared in various scientific journals during 1938 and 1939, and represent the activities of the laboratories in many fields of study.

ELEMENTARY CALCULUS. By G. W. Gaunt. Oxford (England), Clarendon Press; New York, Oxford University Press, 1939. 388 pp., diagrs., charts, tables, 8 × 5 in., cloth, $2.75.
Both differential and integral calculus, with their geometrical applications, are covered in this adaptation from the author's larger treatise. Polar coordinates, centroids, curvature, and Taylor's theorem are included, but partial differentiation and differential equations are omitted. There are many examples to be worked, with the answers grouped at the back of the book.

ELEMENTARY SURVEYING. By W. C. Taylor. Scranton (Pa.), International Textbook Co., 1939. 236 pp., illus., diagrs., charts, tables, $7\frac{1}{2} \times 4\frac{1}{2}$ in., fabrikoid, $2.
The fundamentals of surveying are presented for use as an elementary course, with particular emphasis on the needs of students in other branches of engineering than civil engineering. In addition to general measurement methods, there is material on mapping, meridian determination, and land surveying. Problems accompany some chapters.

ENGINEERING DRAWING, PRACTICE AND THEORY. By I. N. Carter. Scranton (Pa.), International Textbook Co., 1939. 264 pp., illus., diagrs., charts, tables, $11\frac{1}{2} \times 8\frac{1}{2}$ in., cloth, $2.50.
This textbook presents the subject in a novel way, by combining descriptive geometry and engineering drawing in a single course of study which thus covers both theory and practice. Considerable saving of time by elimination of duplication of classroom work is claimed. The book covers the fundamental principles of machine, structural, and topographic drafting, according to accepted drafting-room methods.

ENGINEERS AND ENGINEERING IN THE RENAISSANCE. By William Barclay Parsons. Baltimore (Md.), the Williams and Wilkins Company, 1939. 661 pp., illus., tables, diagrs., 10 × 7 in., cloth, $8.
The author spent many years collecting and sorting material for this book, which was far enough advanced at the time of his death to make finishing the work feasible. It was his contention that while men knew the history of architecture, they had practically no knowledge of the history of engineering. How was it possible, he asked, when man's knowledge of the forces of nature was still so elementary, to control those forces sufficiently to achieve the amazing results that engineering did achieve? It is that question he answers in this book.

(THE) GEOLOGY OF THE ANORTHOSITES OF THE MINNESOTA COAST OF LAKE SUPERIOR. (Minnesota Geological Survey Bulletin 28.) By F. F. Grout and G. M. Schwartz. Minneapolis, Minn., University of Minnesota Press, 1939. 119 pp., illus., maps, tables, $9\frac{1}{2} \times 6$ in., cloth, $3.
The size and distribution of the anorthosite occurrences on the north shore of Lake Superior are discussed, observations are presented on the evidences of their origin, and the geology of the district is described in considerable detail. Also the availability of the most promising masses for commercial purposes is examined.

GEOLOGY OF CHINA. By J. S. Lee. London, Thomas Murby & Co., 1939. 528 pp., illus., diagrs., maps, charts, tables, 9 × 6 in., cloth, 30s.
The first nine chapters of this book, taken with certain additional material from a series of lectures presented by the author, cover the natural physiographic provinces of China, the major formations and movements, tectonic types, and Pleistocene climate in China. The tenth chapter contains in a simplified form essential stratigraphic data. A selected bibliography accompanies each chapter.

GEOLOGY FOR ENGINEERS. By R. F. Sorsbie. London, G. Bell & Sons; Toronto (Canada), Oxford University Press, 1938. 348 pp., diagrs., charts, tables, $9 \times 5\frac{1}{2}$ in., cloth, $3.75.
Part I covers dynamical and structural geology, the study of minerals and rocks, and the identification of rock types. Part II describes field geology methods. The various chapters of Part III demonstrate the application of geological knowledge to the subjects of water supply, building stones, bricks, clays, limes, cements and plasters, roads and canals, rivers, coast erosion, drainage and reclamation, and building sites. This edition has been thoroughly revised and largely rewritten.

HANDBOOK OF CHEMISTRY AND PHYSICS, 23d ed. Edited by C. D. Hodgman. Cleveland (Ohio), Chemical Rubber Publishing Co., 1939. 2221 pp., tables, 7 × 5 in., cloth, deluxe edition, $6; regular edition, $3.50.
This valuable reference work has undergone the customary annual revision. In addition to changes made to bring the information up to date or to improve its presentation, a considerable amount of material has been added on subjects not previously covered. Data from the fields of chemistry, physics, metallurgy, electricity, and mechanics are included in this compilation.

HARDENABILITY OF ALLOY STEELS (Medium and Low Alloy Steels—Up to 5% Alloy). Cleveland (Ohio), American Society for Metals, 1939. 318 pp., illus., diagrs., charts, tables, $9\frac{1}{2} \times 6$ in., cloth, $3.50.
This book contains nine papers presented at a symposium in connection with the twentieth (1938) annual convention of the American Society of Metals. They discuss the hardenability of steels containing up to 5% of alloy. The physics of hardening, the hardenability of plain carbon and low chromium steels, and the effect of additions of silicon and aluminum were among the topics discussed.

JOHN BRUNTON'S BOOK 1812–1899, with an introduction by J. H. Clapham. Cambridge (England), University Press; New York, Macmillan Co., 1939. 163 pp., illus., 8 × 5 in., cloth, $2.50.
Brunton was born in 1812 and died in 1899. The son of an engineer, he adopted the same vocation and began his professional career about 1830. He served under the Stephensons and Isambard Brunel, built a hospital in Crimea during the Crimean war, and later spent many years in railway construction in India. This little book, written for his grandchildren, is a simple interesting account of incidents in the life of a busy engineer during Victorian days.

LEGAL ASPECTS OF ENGINEERING. By W. C. Sadler. New York, John Wiley & Sons, 1940. 631 pp., 9 × 6 in., fabrikoid, $4.
The purpose of this book is to provide engineers with a general understanding of the legal principles that govern engineering practice and of their application by the courts.

MATHEMATICAL METHODS IN ENGINEERING. By T. v. Kármán and M. A. Biot. New York and London, McGraw-Hill Book Co., 1940. 505 pp., diagrs., charts, tables, 9 × 6 in., cloth, $4.
In this introduction to the mathematical treatment of engineering problems the authors present methods in connection with their practical applications in the fields of civil, mechanical, aeronautical, and electrical engineering. Answers to the problems are collected at the end of the book. There are references with each chapter and a group of definitions of words and phrases.

MUNICIPAL ADMINISTRATION. By J. M. Pfiffner. New York, Ronald Press Co., 1940. 582 pp., diagrs., charts, tables, 9 × 6 in., cloth, $4.
Designed primarily as a text and reference book for college courses in political science, this work aims to give a readable general account of the organization and activities of a modern city government. Among the subjects of engineering interest are city planning, municipal airports, streets, water supply, sewerage, and housing.

THE OHIO BRIDGE. By Harry R. Stevens. Cincinnati (Ohio), The Ruter Press, 1939. 213 pp., illus., $7\frac{1}{2} \times 5$ in., cloth.
This fascinating story of one of the oldest crossings on the Ohio River (it was opened in 1867) involves the history of the Covington and Cincinnati Bridge Company, which built the structure. The volume extends from the early days of John A. Roebling, who made the first plan for the bridge, down to the function of the structure in recent floods in the Ohio Valley.

PRINCIPLES OF INDUSTRIAL MANAGEMENT FOR ENGINEERS. By L. P. Alford. New York, Ronald Press Co., 1940. 531 pp., diagrs., charts, tables, $9\frac{1}{2} \times 6$ in., cloth, $4.50.
This book presents and interprets the teachings of management as related to the present period of economic and industrial transition. The subject matter covers the evolution of industry and of management in industry, organization, and standards for the function of control, control of materials in manufacturing, time and motion study fundamentals, classification and cost accounting, maintenance, rate setting, wages, and industrial relations.

PRINCIPLES OF INDUSTRIAL ORGANIZATION, 5 ed. By D. S. Kimball and D. S. Kimball, Jr. New York and London, McGraw-Hill Book Co., 1939. 478 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $4.
The internal organization and procedures of industrial enterprises are comprehensively covered, and industrialism is considered from the broader points of view of economic organization in general. New material treating of the effect of recent federal legislation upon industry has been included in this new edition, and all statistical data have been revised.

PUBLIC SPEAKING FOR TECHNICAL MEN. By S. M. Tucker. New York and London, McGraw-Hill Book Co., 1939. 397 pp., 8 × 6 in., cloth, $3.
The proper presentation of speeches, lectures, etc., is comprehensively covered. Virtues and defects in speaking are brought out through narrative treatment, and working principles to be drawn from these examples are conveniently summarized at the end of chapters. The subject matter covers not only diction, organization of material, and platform technique, but also important helps for the technical speaker on using charts, answering questions, etc.

RAILWAY ENGINEERING AND MAINTENANCE CYCLOPEDIA, 4 ed., 1939. Edited by E. T. Howson and others. New York and Chicago, Simmons-Boardman Publishing Corporation, 1939. 1008 pp., illus., diagrs., charts, tables, 12 × 8 in., fabrikoid, $5.
Rewritten and revised to cover changes in the last ten years, the new edition of this authoritative manual supplies information on engineering, maintenance, and signaling, assembled under their principal headings, in the respective divisions of track, bridges, buildings, water service, and signaling. Methods, materials, and products are described, with supplementary manufacturers' pages giving detailed descriptions of specific products. These technical discussions are preceded by a section defining words, terms, and expressions, which also acts as a general subject index.

REINFORCED CONCRETE DESIGN HANDBOOK. Detroit, American Concrete Institute (7400 Second Boulevard), 1939. 132 pp., tables, diagrs., charts, 9 × 6 in., paper, $2.
The committe charged with the task of preparing this handbook on reinforced concrete design has tried to prepare tables covering as large a range of unit stresses as may be met in general practice, and to reduce the design of members under combined bending and axial load to the same simple form as is used in the solution of common flexural problems.

REPORT ON SEWAGE UTILIZATION FOR THE CITY OF NEW YORK to Honorable Richard H. Gould, Acting Deputy Commissioner, Department of Public Works. By C. G. Flebus, Dept. of Public Works, City of New York, May 1939. 238 pp., illus., charts, maps, tables, $11\frac{1}{2} \times 9$ in.; typewritten manuscript in folder; apply to author.
This report is devoted to a study of the final disposal of the solid matter collected by the sewage treatment plants of New York City. Special attention is directed to possibilities of profitable utilization of this material in the manufacture of fertilizer, soap, paper, fiber board, etc. The report discusses the technical and economic aspects of the question.

THE ST. LAWRENCE SEAWAY. By F. N. Menefee. Ann Arbor (Mich.), Edwards Brothers, Inc., 1940. 325 pp., tables, charts, maps, 8 × 5 in., cloth.
This volume gives a résumé of the history of the St. Lawrence Seaway, discusses the physical features of the region, and presents both engineering and economic estimates of the project. The author has attempted to coordinate all the salient factors involved in bringing negotiations to their present state of completion. The material is so presented that it will be of value to both the engineer and the layman.

SOIL CONSERVATION. By H. H. Bennett. New York and London, McGraw-Hill Book Co., 1939. 993 pp., illus., diagrs., charts, maps, tables, $9\frac{1}{2} \times 6$ in., cloth, $6.
This volume, by the chief of the U.S. Soil Conservation Bureau, is intended as a comprehensive statement of the science and practice of soil and water conservation. The first section, dealing with the problem of soil erosion, describes in detail the extent of erosion and its effects. In the second part measures for soil conservation are presented, and conditions in the different regions of the United States are discussed, with suggestions for their improvement.

THEORY OF PROBABILITY. By H. Jeffreys. Oxford (England), Clarendon Press; New York, Oxford University Press, 1939. 380 pp., diagrs., charts, tables, $9\frac{1}{2} \times 6\frac{1}{2}$ in., cloth, $7.
The chief object of this book is to provide a method of drawing inferences from observational data that will be self-consistent and also usable in practice. The principal types of problem treated in current statistical theory are discussed in detail, and a number of specific applications are given. Tables of K are given, and the factorial function is discussed in appendixes.

TRANSPORTATION IN THE UNITED STATES. By T. W. Van Metre. Chicago, Foundation Press, 1939. 403 pp., maps, tables, $9\frac{1}{2} \times 6$ in., cloth, $3.75.
Dealing chiefly with the railroads, this text first presents a rather extended historical treatment of their development in the United States, with some mention of canals and highways. The second part describes the organization, types of service, finance, and accounting of transportation agencies. The theory and practice of rate making occupy the third part, and in Part IV the regulation of the transportation business is considered. Many references for additional reading are given.

Equipment, Materials, and Methods

New Developments of Interest, as Reported by Manufacturers

New Bucyrus-Erie Hydraulic Scraper

THE BUCYRUS-ERIE H-28 is a 2-wheel hydraulic scraper built for use with tractors rated at 25 to 35 hp. It has a struck capacity of $2^1/_2$ cu yd but will, according to the manufacturer, heap to loads of 3 or 4 cu yd. Since the H-28 with its tractor can be loaded on a regular truck and hauled within usual dimension and load limits, no special permit is needed to haul it over the highways; thus it becomes especially handy for work involving fast moves from job to job. The H-28 can also be used with a rubber-tired tractor, making a complete dirt-moving and traveling layout and a high speed all-on-rubber hookup that will not damage hard-surfaced roads.

Similar in design and construction to the larger Bucyrus-Erie 2-wheel scrapers, the H-28 operates on a safe low-pressure hydraulic system. It has the exclusive Bucyrus-Erie "double curve" cutting edge, and it dumps backwards and behind its wheels like a dump truck. Manufacturer claims the "double curve" cutting edge makes loading easy and quick by "boiling" dirt up into both apron and bowl of the scraper freely, easily, without dead action. Due to the boiling action, dirt does not tend to stick to sides or bottom of scraper and so falls out easily when the load is dumped.

Write to Bucyrus-Erie Company, South Milwaukee, Wis., for the complete story.

Union Metal Absorbs Corrugated Steel Sheet

THE UNION METAL Manufacturing Co., Canton, Ohio, announces that they have absorbed the Corrugated Steel Sheet Piling Corp., formerly of Chicago. Mr. Alexander Mayer, formerly President of Corrugated, joins the Union Metal organization as Manager of Sheet Piling Sales.

The manufacture of Corrugated Steel Sheet Piling, both Standard and Interlock Types, in 8, 10, and 12 gauge steel, will be continued. Light weight and maximum strength are the features claimed for this piling, which has been on the market for a number of years.

Electric Generators

TO ANSWER a continuing demand for larger self-contained "Caterpillar" Diesel Electric Sets, Caterpillar Tractor Co. has added a 66 kw and a 52 kw unit to its line.

The two new sets, the 11–52 and the 13–66, are completely self-contained, and require no gadgets other than a circuit breaker. Both are powered by six-cylinder, heavy-duty Diesel engines; and both require a minimum of maintenance and adjustments. As with the smaller sets, they can be set up and running within an hour after delivery.

There are now five models of these units available, in 15, 20, 30, 52, and 66 kw capacities. More detailed specifications are available from the Caterpillar Tractor Co., Peoria, Ill.

New Electrodes Announced

A STAINLESS STEEL electrode, known as "Stainweld D," is announced by The Lincoln Electric Co., Cleveland, Ohio. "Stainweld D" should be used for arc welding stainless steel of the 25% chromium, 20% nickel type, such as Iron and Steel Institute No. 310. It is also used for welding various stainless steels to mild steel and for welding of steels which are air hardening and cannot be heat treated after welding. "Stainweld D" comes packed in 25 lb containers and is $11^1/_2$ in. in length in five sizes from $^3/_{32}$ to $^1/_4$ in.

The Lincoln Electric Co. also announces two new hard facing electrodes which will be known as "Faceweld No. 1" and "Faceweld No. 12."

These electrodes are cast abrasion-resisting alloys used for hardfacing by the metallic arc process. Both are coated electrodes, have exceptionally good arc characteristics, and produce a smooth dense deposit. Deposits are very resistant to abrasion but not excessively hard and brittle. "Faceweld" bonds well with all types of ferrous alloys.

"Faceweld No. 1" is a general purpose hardfacing electrode and is the softer and tougher of the "Facewelds." It has good abrasion resistance and very high resistance to impact for this class of material. "Faceweld No. 1" is used for surfacing such parts as digger teeth, scarifiers, grader blades, cement plant machinery, etc., by arc welding.

"Faceweld No. 12" is somewhat harder than "Faceweld No. 1" and has superior resistance to abrasion. Its resistance to impact is excellent but not quite as high as "Faceweld No. 1." Applications include screw conveyors, conveyor sleeves, plows, gyratory crushers, power shovel and dragline bucket parts, dredge pump impellers and casings, coal pulverizer jaws, crusher roll plates, etc.

"Faceweld" either No. 1 or No. 12 is furnished in $^1/_4$ in. size—12 in. long and comes packed in 5 lb and 10 lb containers.

Whiteprint Machine

THE OZALID Model "A" Automatic High Speed Whiteprint Machine employs a new quartz envelope high pressure mercury vapor lamp, which provides an extremely fast printing speed, ranging up to 20 lin ft per min, and assures uniform distribution over the entire printing surface. This lamp, guaranteed for 1,000 hours, is new to the reproduction industry, and has been designed and manufactured especially for this machine. The lamp is cooled by an alternating air blast, which passes through the space between the revolving contact cylinder and the fixed cylinder surrounding the quartz envelope high pressure mercury vapor lamp. By alternating the cooling air stream, high temperatures between the left and right sides of the contact cylinders are avoided. A small, metered quantity of cooling air is also allowed to pass through the inner cylinder and over the quartz tube.

The Ozalid Model "A" Automatic High Speed Whiteprint Machine is available in two sizes for production of prints up to and including 42- and 54-in. widths. An ingenious device automatically separates the print from the original after exposure. The original is returned to the operator in front of the machine, while the exposed print is automatically conveyed to the developing unit, where after dry development, it is discharged at the rear of the machine.

A variable transformer in the primary circuit permits a variation of intensity of the high pressure mercury vapor lamp from full brilliancy to 60 per cent of light without loss of energy. This dimming arrangement allows the operator to select the desired intensity, and permits continuous and uniform production of prints, despite variations in tracings. In this machine, positive printing and dry developing are synchronized.

CURRENT PERIODICAL LITERATURE

Abstract of Magazine Articles on Civil Engineering Subjects

Selected items for the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page, plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

BACKWATER EFFECT. Backwater Effects of Bridges. *U.S. Waterways Experiment Station—Hydraulics Bul.*, vol. 2, no. 3, July 1, 1939, pp. 12–14. Results of study of hydraulic models to determine backwater effect of bridges at Johnstown, Pa.

COMBINED. St. Louis Municipal Bridge Is Ready for Use, M. H. Doyne. *Ry. Age*, vol. 107, no. 25, Dec. 16, 1939, pp. 923–935. Description of facilities for railway operation over municipal bridge across Mississippi River, together with review of history of this structure, built by city of St. Louis 22 years ago.

CONCRETE ARCH, FINLAND. Farjsund Bridge, Finland. *Engineer*, vol. 168, no. 4379, Dec. 15, 1939, p. 589. Brief illustrated description of new highway bridge uniting two shores of Aaland Gulf; consists of reinforced concrete arch and two reinforced concrete girder approaches, each comprising two spans of 49 and 44 ft; width 21 ft; arch designed with fixed ends and has theoretical span of 426 ft and corresponding rise of 58 ft 6 in., giving rise span ratio of 0.135.

CONCRETE ARCH, GREAT BRITAIN. New Waterloo Bridge, London. *Engineering*, vol. 148, no. 3853, Nov. 17, 1939, pp. 545–546 and 556, supp. plates. Illustrated description of progress to date on new bridge, which is being erected on almost same center line as old; constructed entirely of concrete having only five spans, compared with nine spans of Rennie's bridge.

CONCRETE ARCH, ITALY. Il Ponte Duca d'Aosta. *Strade*, vol. 21, no. 10, Oct. 1939, pp. 519–523. Features of Duca d'Aosta concrete arch bridge, over Tiber River, Rome, Italy, having total length of 220 miles; maximum span 100 miles.

CONCRETE FRAME, OLYMPIA, WASH. Rigid-Frame Concrete Bridge at Olympia Has Novel Features. *Concrete*, vol. 47, no. 10, Oct. 1939, pp. 3–4. Brief description of Tumwater Bridge across Des Chutes River designed as series of rigid frames of reinforced concrete; special features, general dimensions, and structural design are reviewed.

CONCRETE, SLAB. Moments in Simple Span Bridge Slabs with Stiffened Edges, V. P. Jensen. *Univ. Ill. Eng. Experiment Station—Bul.*, No. 315, vol. 36, no. 97, Aug. 1, 1939, 105 pp. $1. Report on investigations by University of Illinois in cooperation with Public Roads Administration and Illinois Division of Highways; moments in slab and edge members; live load moments; illustrative problems; moments due to single concentrated load on transverse center line of slab.

MASONRY ARCH, ITALY. Allargamento del Ponte in muratura sul fiume Toce al Km. 52 + 555 in dipendenza del raddoppio della linea Arona-Domodossola, P. Bona. *Rivista Tecnica delle Ferrovie Italiane*, vol. 56, no. 3, Sept. 15, 1939, pp. 141–149. Methods and equipment used in widening multiple-arch masonry bridge over Toce River on Arona-Domodossola railroad line, Italy, consisting of 6 spans—each 25 miles long; details of arch centerings constructed of tubular train works.

STEEL, FRANCE. Les nouveaux ponts de la région Parisienne, C. E. See. *Technique Moderne*, vol. 31, no. 15, Aug. 1, 1939, pp. 537–542. New bridges in Paris; general description of new bridge of Carrousel, 34 miles wide, 33 miles between parapets; bridge of Saint Cloud, 30 miles wide and 10 miles between parapets; further descriptions are given of bridge of Neuilly; notes on technique of welding applied to all bridges described.

STEEL TRUSS, CANADA. New Highland Creek Bridge. *Can. Engr.*, vol. 77, no. 19, Nov. 7, 1939, pp. 4–6. Description of new features incorporated in 755-ft 5-span steel truss highway bridge near Toronto, Ontario, effecting saving of $25,000 over similar type of structure, erected 17 years ago, by adopting of cantilevered wing walls, smaller abutments, extra approach spans, and wider stringer spacing; detail of new finger-type expansion joint.

STEEL TRUSS, RAISING. Long Bridge Raised by Unique Procedure, E. Harsch. *Eng. News-Rec.*, vol. 123, no. 23, Dec. 7, 1939, pp. 75–79. Methods used in raising Tennessee River bridge (at Guntersville, Ala.), consisting of 3-span 767-ft continuous steel truss, which was lifted 17 ft as unit, and 1,600 ft of approach structure (both concrete I-beam and steel girder construction), spans of which were raised distances varying from $8^1/_2$ to 17 ft, with aid of novel gantry crane; hoisting arrangement.

SUSPENSION, AUSTRIA. La construction du nouveau pont "Reichsbruecke" sur le Danube a Vienne, J. Wagner. *Ossature Métallique*, vol. 8, no. 10, Oct. 1939, pp. 415–421. Design and construction of new eye-bar chain suspension bridge over Danube River in Vienna. Abstract of paper previously indexed from *Zentralbatt der Bauverwaltung*, Mar. 1, 1939.

SUSPENSION, BRITISH COLUMBIA. Lions Gate Bridge at Vancouver. *Engineer*, vol. 168, no. 4377, Dec. 1, 1939, pp. 534–537 and 544. Illustrated description. Similar description indexed in *Engineering Index* 1938, p. 161, from *Civ. Eng.* (London), Jan. and Feb., 1938.

SUSPENSION, CABLE SADDLES. Welded Cable Saddles for Tacoma Narrows Bridge, J. Jones. *Eng. News-Rec.*, vol. 123, no. 23, Dec. 7, 1939, pp. 91–92. Design and construction of cable saddles made of welded structural plates, for 17-in. cables of 2,800-ft span suspension bridge over Tacoma Narrows in state of Washington; stages of saddle assembly preparatory to final welding operation.

SUSPENSION, DEER ISLE-SEDGWICK, ME. Deer Isle–Sedgwick Suspension Bridge, R. G. Skerrett. *Compressed Air Mag.*, vol. 44, no. 9, Sept. 1939, pp. 5974–5977. Design and construction of bridge connecting Deer Isle to mainland at Sargentville, Me., consisting of central span 1,080 ft long and two by-spans 484 ft long each.

SUSPENSION, NEW YORK CITY. Bronx-Whitestone Suspension Bridge. *Engineer*, vol. 168, nos. 4374 and 4375, Nov. 10, 1939, pp. 462–464, and Nov. 17, pp. 487–489. Illustrated description of bridge with two approach highways. Previously indexed from various sources.

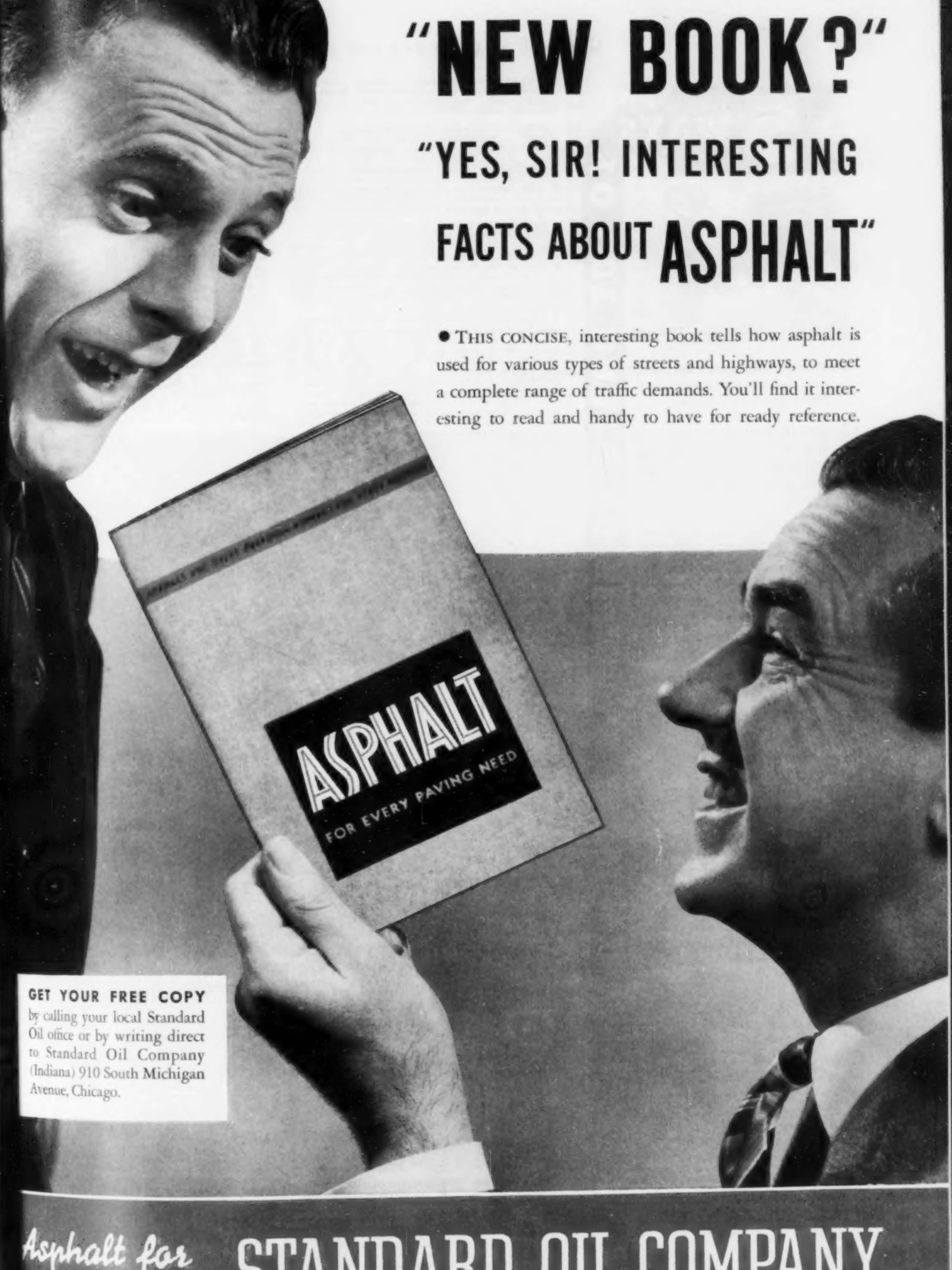
SUSPENSION, RECONSTRUCTION. Reconstruction of Menai Suspension Bridge. *Engineering*, vol. 148, no. 3857, Dec. 15, 1939, pp. 655–657. Work of redesigning entrusted to Alexander Gibb; reconstruction carried out by Dorman, Long and Co.; work consisted in erection of temporary steel towers, above existing main piers, carrying cables to give partial support to existing bridge floor, and to enable old outer chains of bridge to be removed and new chains and anchorages erected.

SUSPENSION, VANCOUVER. Le pont suspendu de Lion's Gate a l'entrée du port de Vancouver (Canada), R. G. Skerrett. *Technique des Travaux*, vol. 15, no. 10, Oct.–Nov. 1939, pp. 529–536. Design and construction of Lion's Gate suspension bridge over entrance to port of Vancouver, British Columbia, including main span 472 miles long and plate girder approach 659 miles long; manufacture of cables; details of anchorages.

WOODEN. Treated Timber Bridges for Low-Cost Roads, J. F. Seiler. *Eng. & Contract Rec.*, vol. 52, no. 37, Sept. 13, 1939, pp. 8–10. Features of wooden bridge types particularly suitable for secondary road systems; recent developments in application of timber to bridge construction; spiking and doweling; composite decks; placing of shear developers; concreting sequence.

BUILDINGS

ACOUSTICS. Control of Sound in Buildings. *Arch. Rec.*, vol. 87, no. 1, Jan. 1940, pp. 66–73. Review of advances in technique of sound control in broadcasting and sound-recording studios.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as well as in non-specialized buildings; sonic environment; materials and design for control of reverberation; performance of various sound-insulating materials.

AIR CONDITIONING, STORE BUILDINGS. Year 'Round Conditioning System for Store Has "Three-in-One" Coil, J. M. Aikman. *Heating, Piping & Air Conditioning*, vol. 12, no. 2, Feb. 1940, pp. 117–118. Air-conditioning system which was designed by author for store in Minneapolis incorporates unique features, including compact arrangement of equipment, three zones combined in one coil, and method of control.

HOUSING, BUFFALO, N. Y. Close Coordination Speeds Buffalo Housing Project. *Eng. News-Rec.*, vol. 123, no. 25, Dec. 21, 1939, pp. 44–47. Description of job organization for construction operations on 50 buildings of Commodore Perry ow-rent housing project being built in Buffalo, N.Y.; brick and concrete design; contract cost comparisons on three Buffalo low-rent housing projects.

STEEL, WELDED. Standard Welded Connections for Steel Building Frames—I and II, D. V. Isaacs. *Commonwealth Engr.*, vol. 27, nos. 3 and 4, Oct. 2, 1939, pp. 79–87, and Nov. 1, pp. 139–144. Discussion of simple types of standard welded connections; plastic yield in steel structures; standard connections, joists to columns; standard sizes for top restraining cleats; rules for approximately balancing column moments; connections on exterior columns; elimination of fatigue conditions under fluctuating live loads; unbalanced moment on exterior columns; maximum sizes of restraining cleats.

WALLS, DAMPNESS. Waermetechnische und wirtschaftliche Fragen im Wohnungsbau, W. Schuele. *Gesundheits-Ingenieur*, vol. 62, no. 44, Nov. 4, 1939, pp. 629–634. Results of German experimental studies of moisture content and distribution of moisture in outer walls of dwellings; effect of weather conditions on moisture distribution in walls.

CIVIL ENGINEERING

CONSTRUCTION ARTICLES. New Short Cuts to Construction Profits. Reprint. New York, *Eng. News-Rec.*, 1939, 258 pp., figs., diagrs., charts, tables. Selection of short articles previously published in *Engineering News-Record;* discussion solution of various unusual construction problems; grading, excavation, tunneling; concrete design, mixing, and placing; construction methods and appliances; welding, roads, and streets; water supply and treatment; sewerage and garbage disposal; surveying and mapping, etc.

CONCRETE

ARCHES. Cintres mobiles pour exécution des voutes en béton armé, V. Cherre. *Technique des Travaux*, vol. 15, no. 10, Oct.–Nov. 1939, pp. 537–552. Design of movable centerings for construction of cylindrical and conoidal concrete arches; numerical examples; design of centerings for curved sheds, hangar roofs, etc.

BRIDGES, DESIGN. Continuous Concrete Bridges. Chicago (Ill.), Portland Cement Assn., 1939. 92 pp., figs., diagrs., tables, charts. Design procedure based upon moment-distribution method of analysis, which reduces determination of moments and shears to substitution of charted values of physical constants of members and fixed end moments in relatively simple formulas; design of continuous bridge of any practical degree of unsymmetrical arrangement consisting of members of variable and unsymmetrical moment of inertia.

CONSTRUCTION. Job Problems and Practice. *Am. Concrete Inst.—J.*, vol. 11, no. 3, Jan. 1940, pp. 313–320. Practical discussion of following problems in concrete construction: Sea water for mixing concrete; efflorescence on concrete bricks; compressed air jets as means of placing concrete, M. L. Davis; lifting force of freshly placed concrete, A. Ruettgers.

CONSTRUCTION, FORMS. Concrete Surfaces Improved by Absorptive Form Lining. *Eng. News-Rec.*, vol. 124, no. 1, Jan. 4, 1940, pp. 64–66. U. S. Bur. of Reclamation tests of building boards as absorptive lining for concrete forms for spillways of high dams, which should be effective in absorbing excess water and air but which will not bond to concrete; field tests at Grand Coulee Dam; comparison of concrete surfaces obtained with regular forms with tongue-and-groove lagging and forms lined with best absorptive board used in Grand Coulee Dam tests.

CONSTRUCTION, FORMS. Construction Design Chart—XLIX, J. R. Griffith. *Western Construction News*, vol. 15, no. 1, Jan. 1940, p. 27. Alignment chart for design of plywood form sheathing used in concrete construction; numerical examples.

CONSTRUCTION, SPECIFICATIONS. Proposed Revisions of "Building Regulations for Reinforced Concrete," A. W. Stephens and R. R. Zipprodt. *Am. Concrete Inst.—J.*, vol. 11, no. 3, Jan. 1940, pp. 237–264. Report of Committee 501 of American Concrete Institute proposing revisions to Tentative Building Regulations for Reinforced Concrete, adopted as Tentative Standard of American Concrete Institute at 32d Annual Convention, Feb. 25, 1936; errata to Building Regulations for Reinforced Concrete.

CONSTRUCTION, VACUUM PROCESS. Vacuum Concrete, J. J. Creskoff. *Can. Engr.*, vol. 77, no. 23, Dec. 5, 1939, pp. 4–8. Theory and technique of vacuum process of concrete construction; characteristics of vacuum concrete; results of tests; bond strength; shrinkage; national defense applications; water-tightness; wear tests.

CURING. Testing Efficiency of Concrete Curing Methods, H. D. Dewell. *Western Construction News*, vol. 14, no. 12, Dec. 1939, pp. 403–405. Results of curing by leaving wooden forms in place are compared to effectiveness of other coverings in careful study made under severe climatic conditions; relative efficiencies of curing methods.

DISINTEGRATION. Concrete in Sulphate-Bearing Clays and Ground Waters. *Water & Water Eng.*, vol. 41, no. 517, Dec. 1939, pp. 574–575 and 577. Classification of sulphate soil conditions and precautionary measures; sampling of clays and ground waters.

FLOORS. Precast Joist Concrete Floor Systems, F. N. Menefee. *Am. Concrete Inst.—J.*, vol. 11, no. 3, Jan. 1940, pp. 297–312. Report of Committee 711 of American Concrete Institute, presenting critical examination of precast concrete joist and superimposed concrete floor systems and construction methods as practiced in the United States; recommended practice in design and construction of precast joist floors; joist spacing and floor thickness; manufacturing data.

ROADS AND STREETS. Developments Regarding Concrete Pavements During 1939, W. F. Tempest. *Roads & Streets*, vol. 83, no. 1, Jan. 1940, pp. 86–87. Review of 1939 advances in design and construction of concrete roads and streets in the United States.

DAMS

BUTTRESS. Large Slab-Buttress Concrete Dam for Hydroelectric Project. *Commonwealth Engr.*, vol. 27, no. 4, Nov. 1, 1939, pp. 132–135. Features of flat-slab buttress concrete dam, 300 ft long and over 74 ft high, being constructed for hydroelectric project on Kiewa River, about 145 miles northeast of Melbourne, Australia; specifications for concrete mixing and placing; preparation of surfaces for concreting.

CONCRETE ARCH, OKLAHOMA. Concrete for Pensacola Dam, M. G. Fuller. *Eng. News-Rec.*, vol. 124, no. 5, Feb. 1, 1940, pp. 42–46. Making and placing of concrete for Pensacola multiple-arch dam over Grand River in northeastern Oklahoma, consisting principally of 51 concrete arches, 140 ft high in river bed, resting against hollow buttresses 84 ft center-to-center; crane and bucket placement; concrete batching plant; design of arches and buttresses.

CONCRETE GRAVITY, AUSTRALIA. Water Conservation and Flood Protection, W. H. Nimmo. *Commonwealth Engr.*, vol. 27, no. 6, Jan. 1, 1940, pp. 197–203. Design and construction of Somerset concrete gravity dam, 190 ft maximum height and 1,000 ft long, for water supply of Brisbane, Australia, and for flood control; features of sluice tunnels and energy dissipators.

CONCRETE GRAVITY, GERMANY. Die Talsperre Pirk. *Gesundheits-Ingenieur*, vol. 62, no. 44, Nov. 4, 1939, pp. 637–639. Plans for design and construction of slightly curved concrete gravity overflow dam, maximum height 24.5 m and 257 m long, across Weisse Elster River in Germany.

CONCRETE GRAVITY, MAINTENANCE AND REPAIR. Repairing Damaged Concrete on Face of Spaulding Dam. *Eng. News-Rec.*, vol. 123, no. 25, Dec. 21, 1939, pp. 66–67. Stopping seepage through upper portions of Spaulding Dam, California, by shotcrete coating, for most part 2 to 4 in. thick, firmly anchored in place with steel dowels imbedded in old concrete.

FLOW OF FLUIDS

MEASUREMENT. Measurement of Fluids with Orifice and Flow Nozzle, H. Escher. *Commonwealth Engr.*, vol. 27, no. 4, Nov. 1, 1939, pp. 119–125. Review of latest practice with critical comparison of methods and recommendations; coefficient of discharge and pressure tap connections; flow nozzles for low Reynolds' numbers; flow nozzle versus orifice; metering of dirty fluids; orifice and flow nozzles for free inlet and outlet measurement; permanent pressure drop through constricting devices and flow nozzle venturi; measurement of pulsating flow with orifice. Bibliography.

FOUNDATIONS

BRIDGE PIERS. Substructure for Long Bridge Built in Fast Time. *Eng. News-Rec.*, vol. 124, no. 5, Feb. 1, 1940, pp. 69–71. Construction, in nine months, of 69 bridge pier foundations for Jamestown Bridge, 6,982 ft long, spanning western passage of Narragansett Bay, Rhode Island; features of floating equipment used in construction.

BRIDGE PIERS. Tremie Concreting Scheme Simplifies Foundation Job, W. F. Way. *Eng. News-Rec.*, vol. 124, no. 1, Jan. 4, 1940, pp. 43–44. Placing 750 cu yd of concrete at base of bridge pier at Ruskin power plant in British Columbia where rock was subjected to severe erosion from water flowing over spillway; protective concrete

armor placed through tremies by method devised to avoid either horizontal joints between successive pours, or dangerous stresses in forms large enough to support entire mass of fresh concrete.

DESIGN. Eccentric-Load Formula, D. B. Hall. *Eng. News-Rec.*, vol. 124, no. 1, Jan. 4, 1940, p. 42. Formula for computing unit stress at corner nearest result in load on rectangular section subjected to load which is eccentric in two directions.

PILE. Fundamentals of Pile Foundations, I. F. Morrison. *Can. Engr.*, vol. 77, no. 25, Dec. 19, 1939, pp. 4–7 and 24. Discussion of several types of pile foundations showing fundamental principles regarding reciprocal action between ground, piles, and structure supported by them; classification of piles; statics of single pile; pile groups; pile-driving formulas.

STEEL PILE. Steel Pile Piers for Railroad Bridges. *Eng. News-Rec.*, vol. 123, no. 25, Dec. 21, 1939, pp. 48–49. Description of Canadian National Railways design of bridge pier consisting of closely spaced steel H-piles that serve not only as foundation but as pier structure itself.

SUBWAY CONSTRUCTION, SOIL TESTING. Soil Tests Check Chicago Subway Work, R. B. Peck. *Eng. News-Rec.*, vol. 123, no. 23, Dec. 7, 1939, pp. 87–88. Methods of underground exploration, both in advance of construction and as excavation proceeds, in building Chicago subway; exploratory borings; settlement and pressure studies; soil profiles.

HYDRAULIC ENGINEERING

ALIGNMENT CHARTS. Construction Design Chart—XLVIII, J. R. Griffith. *Western Construction News*, vol. 14, no. 12, Dec. 1939, p. 419. Alignment chart for solving equation of theoretical power required to lift water through any given heads; numerical examples.

HYDROLOGY AND METEOROLOGY

EARTHQUAKES. Geological Meaning of Deep-Seated Earthquakes, L. B. Slichter. *Pan.-Am. Geologist*, vol. 72, no. 5, Dec. 1939, pp. 344–348. Commentary on mystery surrounding nature and cause of deep quakes; odds seem to be about 70 to 1 that moon's position does influence times of occurrence of South American quakes; facts strongly suggest that common stress system, operative at both shallow and deep levels, is common cause of shallow and deep quakes.

SILT, TRANSPORTATION. Betrachtungen ueber die Geschiebebewegung im fliessenden Wasser, W. Sperling. *Bautechnik*, vol. 17, nos. 47/48, Nov. 3, 1939, pp. 598–601. Review of recent studies on occurrence and forms of silt bedload materials in streams; effect of wave action; forms of shoals.

WATER WELLS, YIELD. Calculating Yield of Well, Taking Account of Replenishment of Groundwater from Above, J. H. Steegewentz and B. A. Van Nes. *Water & Water Eng.*, vol. 41, no. 517, Dec. 1939, pp. 561–563. Theoretical mathematical discussion with special reference to conditions obtaining in polders of reclaimed area of Netherlands; results of pumping tests of wells in Netherlands.

IRRIGATION

CANALS, CALIFORNIA. Contra Costa Canal. *Western Construction News*, vol. 14, no. 12, Dec. 1939, pp. 397–400. Construction of first 20 miles of concrete lined canal, with present capacity of 350 cu ft per sec, conveying water from Central Valley of California to Upper San Francisco Bay for irrigation and municipal water supply.

CANALS, MAINTENANCE AND REPAIR. Maintenance of Irrigation Canals. *Western Construction News*, vol. 14, no. 12, Dec. 1939, pp. 407–409. Review of maintenance practice for irrigation canals of Fresno irrigation district, California; mowing and burning of weeds; reshaping bottom and banks of canals; cleaning small ditches; organizing work; costs; major maintenance.

LAND GRADING. Land Grading Calculations, C. V. Givan. *Agric. Eng.*, vol. 21, no. 1, Jan. 1940, pp. 11–12. Theoretical mathematical discussion of methods of planning grading of irrigable lands to provide for balance between cut and fill.

SASKATCHEWAN. Development of Irrigation Projects in Saskatchewan, G. N. Denike. *Agric. Eng.*, vol. 20, no. 12, Dec. 1939, pp. 474–476. Review of progress in development of irrigation projects in Saskatchewan; description of equipment for leveling of irrigated land.

LAND RECLAMATION AND DRAINAGE

DRAINAGE PIPE. Causes of Failure in Tile Drains, F. F. Shafer. *Agric. Eng.*, vol. 21, no. 1, Jan. 1940, pp. 17–18 and 20. Analysis of author's experience with causes of tile drain failures under following headings: manufacturing processes and material used; improper design of ditches; improper construction; lack of inspection and maintenance; and physical structure of soil. Before Am. Soc. Agric. Engrs.

DRAINAGE PIPE, SPECIFICATIONS. Pipe and Drain Tile. *Am. Soc. Testing Matls.—Standards*, Pt. II, 1939, pp. 221–280 and 983–984. Specifications for drain tile, clay sewer pipe, concrete sewer pipe, reinforced concrete sewer and culvert pipe, and concrete irrigation pipe; recommended practice for laying sewer pipe; definitions of terms relating to clay sewer pipe.

MATERIALS TESTING

BUILDING MATERIALS, SPECIFICATIONS. Masonry Building Units, Stone, and Slate. *Am. Soc. Testing Matls.—Standards*, Pt. II, 1939, pp. 79–81, 100–155, and 916–948. Tentative specifications and methods of testing brick, structural tile, concrete masonry units, and building stone and slate.

CONCRETE. Application of Sonic Method to Freezing and Thawing Studies of Concrete, F. B. Hornibrook. *Am. Soc. Testing Matls.—Bul. No. 101*, Dec. 1939, pp. 5–8. Apparatus for determining fundamental flexural frequency of specimen vibrating as free-free bar developed and used at National Bureau of Standards; apparatus described; data obtained in testing concretes subjected to cycles of freezing and thawing; effect of change in temperature and moisture content on natural frequency of concrete specimens; etc. Bibliography.

CONCRETE AGGREGATES. Concrete Aggregate Development on Clayton Hydro Project, G. W. Hutchinson. *Am. Concrete Inst.—J.*, vol. 11, no. 3, Jan. 1940, pp. 273–295. Development of both fine and coarse aggregate for concrete on Clayton Hydro Project, near Radford, Va., covering studies of particle shape and gradation which resulted in development of stone sand of high quality and enhancement in value of coarse aggregate; preliminary tests of aggregates; freezing and thawing tests; effect of cement on placeability.

SOILS, ANALYSIS. California Practice in Obtaining Undisturbed Soil Samples, T. E. Stanton, Jr. *Am. Soc. Testing Matls.—Bul. No. 101*, Dec. 1939, pp. 9–12. Most soil explorations in California are made with special soil sampler designed by engineers of Materials and Research Dept. of California Division of Highways; two sizes are regularly used—heavy power-operated sampler designed for deep borings, ranging up to 200 or 300 ft in depth, and light weight sampler for hand operation; description of samplers.

SUBSOILS. Soils. *Am. Soc. Testing Matls.—Standards*, Pt. II, 1939, pp. 451–476 and 1048–1056. Tentative methods of surveying and sampling soils for highway subgrades; preparing soil samples for mechanical analysis; and determination of subgrade soil constants, mechanical analysis of soils, test for centrifuge and field moisture equivalent of soils, test for liquid limit of soils, plastic limit and plasticity index of soils, and test for shrinkage factors of soils.

MUNICIPAL ENGINEERING

CITY AUTHORITY. City Authority Over Streets, L. T. Parker. *Mun. Sanitation*, vol. 11, no. 1, Jan. 1940, pp. 20–22. Review of legislation and recent court decisions on rights of holders of property abutting on streets, also on municipal authority over streets; prescriptive rights; ministerial functions.

PORTS AND MARITIME STRUCTURES

PIERS, RECONSTRUCTION. Wharf Gets 600 New Piles Through Old Deck. *Eng. News-Rec.*, vol. 123, no. 23, Dec. 7, 1939, pp. 68–70. Replacing deteriorated concrete piles of wharf at Long Beach, Calif., by drilling 18-in. holes through reinforced concrete deck, 36 in. thick, and driving steel H-beams through heavy granite riprap; encasing of new pile tops in steel jackets filled with concrete.

TOLEDO, OHIO. Port of Toledo, Ohio. *U.S. Army Corps Engrs.—Lake Series, No. 7*, 1939, 108 pp. supp. plates. Revised report on port of Toledo, Ohio, containing data showing movements of commerce through port, facilities available for handling traffic, and rates and charges applying against it.

RAILROADS, STATIONS, AND TERMINALS

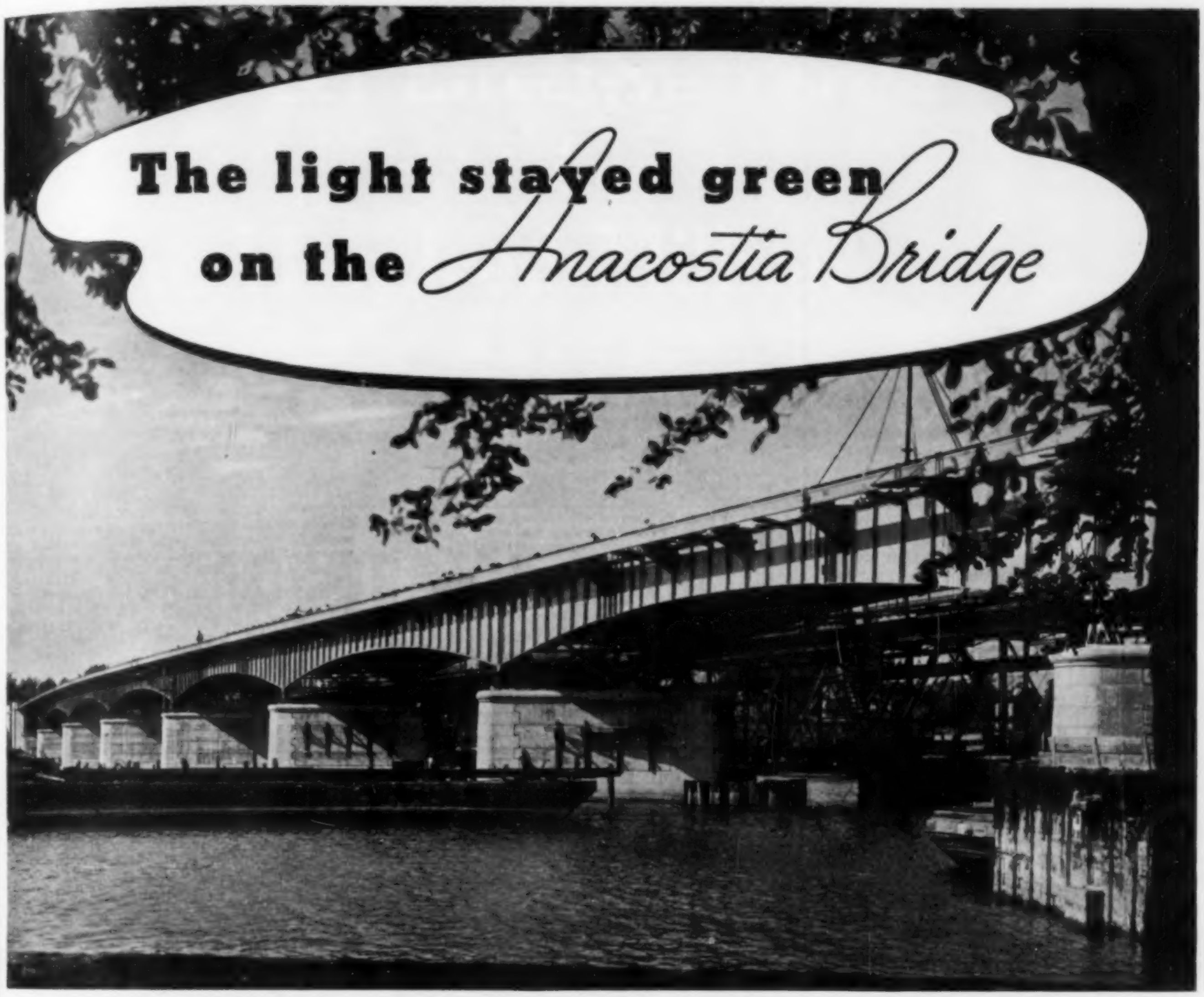
RAILROAD STRUCTURES. Meeting Today's Requirements in Railway Structures, A. I. Hawk. *Ry. Eng. & Maintenance*, vol. 36, no. 1, pt. 1, Jan. 1940, pp. 24–27. Radical changes in last 10 years; review of demands that changes have already made on buildings and forecast of future requirements with respect to building construction and maintenance. Before Am. Ry. Bridge & Bldg. Assn.

ROADS AND STREETS

ASPHALT. Mineral Aggregates for Asphalt Highway Surfaces, D. J. Steele. *Can. Engr.*, vol. 77, no. 26, Dec. 26, 1939, pp. 12–14 and 16. Classification of mineral aggregates for asphalt roads on basis of grading; grading specifications; standard tests of mineral aggregates; evaluation and selection of aggregates for asphalt roads. Before 1939 Nat. Asphalt Conference.

BRICK. Brick Pavements Past, Present and Future, G. F. Schlesinger. *Roads & Streets*, vol. 83, no. 1, Jan. 1940, pp. 67, 70–71, and 74. Historical review of development of brick road construction; present practice; vibrated monolithic type of brick pavement; future prospects.

BRICK. Machine-Refined Brick Paving, G. J. Thormyer. *Eng. News-Rec.*, vol. 124, no. 1,



General contractors, Penker Construction Company, Cincinnati; Consulting Engineers, Parsons, Klapp, Brinckerhoff and Douglas, New York City. C. R. Whyte, Engineer of Bridges, D. C.

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To permit the uninterrupted flow of Pennsylvania Avenue traffic, this new continuous deck girder bridge across the Anacostia River is being built in two stages. When the southern 28-ft. roadway was completed, traffic was diverted to this channel and the northern roadway erected on the site of the old steel truss structure in service since 1885. Nine 154 foot spans carry the two separate 28-foot roadways.

The construction of the piers was characterized by similar efficient practice on the part of the general contractor. The granite facing was set up two courses ahead of the concrete to serve as forms. The rectangular cofferdams for the river piers were constructed of Bethlehem Z-piling, braced by steel channel wales.

As builders of the Golden Gate, George Washington, Ambassador and Tacoma Narrows Bridges among many others, Bethlehem has the background, the experience and the facilities to handle steel construction contracts of any size with maximum efficiency.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

Jan. 4, 1940, pp. 36–38. Report on mechanized construction of 2-mile brick pavements of improved design at East Canton, Ohio, featuring lip curb of specially shaped brick, curb inlets for surface drainage, and combination expansion joint of unusual construction.

CONSTRUCTION. Modern Excavating Methods. *Can. Engr.*, vol. 77, no. 24, Dec. 12, 1939, pp. 2–4 and 16. Outline of earth-moving methods employed in construction of Pennsylvania Turnpike, largest single highway project ever attempted in United States; amount of excavation and principal items used in construction of roadway and tunnels; excavating and grading equipment.

DESIGN. Divided Highway Design—I. *Eng. News-Rec.*, vol. 123, no. 25, Dec. 21, 1939, pp. 38–41. Development of divided roads in United States; design details that are crystallizing out of study of trial roads; cross profile design and dimensions.

EARTH. Nebraska Tests Soil Processing with Cement, Asphalt Emulsion and Tar. *Construction Methods*, vol. 22, no. 1, Jan. 1940, pp. 80–82, 110, 112, 114, and 116. Comparative study of three types of processed soil roads built with portland cement, asphalt emulsion, and tar by Nebraska Department of Roads and Irrigation.

EMBANKMENTS, BLASTING. Accelerated Settlement of Embankments by Blasting, A. W. Parsons. *Pub. Roads*, vol. 20, no. 10, Dec. 1939, pp. 197–202. Recent experience with blasting as means of accelerating fill settlement; underfill blasting method of stabilizing fill; results of consolidation tests on swamp material; locations of charges for blasting swamp mat and underfill.

FAILURE. Faults and Troubles of Road Surfacing, A. C. Hughes. *Surveyor*, vol. 96, no. 2051, Dec. 29, 1939, pp. 533–536. Discussion of causes of failure of various types of road surfaces; avoidance of surfacing faults.

UNITED STATES. State Highway Construction. *Roads & Streets*, vol. 83, no. 1, Jan. 1940, 10 pp. between pp. 98–120. Reports from highway officials showing mileage completed and expenditures in 1939 and probable mileage and expenditures in 1940.

SEWERAGE AND SEWAGE DISPOSAL

BOILERS, GAS. Boiler Burns Sludge Gas and City Gas Simultaneously, G. E. Griffin. *Mun. Sanitation*, vol. 10, no. 12, Dec. 1939, pp. 585–586. Description of arrangement for burning sludge gas and manufactured gas in one burner, for heating boiler in administration building of Grass Island sewage disposal plant, Greenwich, Conn.

BRAZIL. Revisão das rêdes de esguotos da cidade de S. Paulo. *Reparticao de Aguas e Esgotos S. Paulo—Boletim*, vol. 4, no. 8, Dec. 1939, pp. 15–19 supp. plates. Revision of sewer network of city of Sao Paulo; district maps, descriptive and statistical data.

DISPOSAL PLANTS, DENVER, COLO. Settling and Filtration at Denver Works, F. M. Veatch. *Mun. Sanitation*, vol. 11, no. 1, Jan. 1940, pp. 8–10. Features of new 54-mgd sewage disposal plant of Denver, Colo.; operating results and costs.

DISPOSAL PLANTS, MANAGEMENT. Interesting Public in Sewage Treatment Works. *Mun. Sanitation*, vol. 10, no. 12, Dec. 1939, pp. 598–600. Discussion of advantages and disadvantages of publicity educational programs for interesting public in sewage disposal undertaking.

DISPOSAL PLANTS, MILITARY CAMPS. Sewerage for 18,000 Soldiers, H. E. Moses. *Mun. Sanitation*, vol. 11, no. 1, Jan. 1940, pp. 11–13. Description of plant for disposal of sewage from military reservation of Pennsylvania National Guard, where population varies from small maintenance force to summer-time peak, when 18,000 men may be encamped; pumping station; Imhoff tanks; sludge beds; design and construction.

DISPOSAL PLANTS, OPERATION. Notes on Operation of Sewage Treatment Works in South Africa, H. T. Clausen. *Instn. Mun. & County Engrs.—J.*, vol. 66, no. 11, Nov. 7, 1939, pp. 369–373, (discussion) 373–375. Review of operating practice of sewage disposal plants in Johannesburg, and other cities in South Africa.

GREAT BRITAIN. Modern Sanitation in Great Britain, D. M. Watson. *Instn. Civ. Engrs.—J.*, no. 2, Dec. 1939, pp. 125–146. Review of modern sewage disposal practice in Great Britain; central administrative control of design; multiplication of coordinated drainage systems; liquid wastes from factories; contamination of ground water; sea outfalls; mechanization; screenings; grit; pretreatment; sedimentation; activated sludge; biological filters; sludge treatment; use of sludge gas; storm water tanks.

IRRIGATION. Sewage Treatment Coupled with Irrigation, F. W. Veatch. *Eng. News-Rec.*, vol. 124, no. 1, Jan. 4, 1940, pp. 49–50. Description of new 20-mgd sewage disposal plant of Pueblo, Colo., providing partial treatment and leaving final treatment to broad irrigation methods; butane gas used to supplement sludge gas as auxiliary and standby fuel for engine operation; boilers for heating service and circulating water system.

LEAKAGES. Bentonite Stops Sewer Leakage, E. C. Hallock. *Eng. News-Rec.*, vol. 124, no. 1, Jan. 4, 1940, p. 63. Method of sealing leaking joints of 8-in. clay tile sewer in Boyerstown, Pa., with mixture of quick dispersing bentonite clay and water, which was forced down into holes over and near sewer pipe.

NEUTRALIZATION. Entsaeuerungsanlagen fuer Abwaesser, H. Keppner. *Gesundheits-Ingenieur*, vol. 62, no. 50, Dec. 16, 1939, pp. 706–708. Classification of acid sewage; discussion of injurious effects of acid sewage; principles of design and operation of sewage installation for neutralization of acid sewage. Bibliography.

RUNOFF. Runoff Coefficients by Model Tests, I. Gutmann. *Water Works & Sewerage*, vol. 86, no. 12, Dec. 1939, pp. 506–508. Review of Italian, German, and Russian experimental studies with hydraulic models for determination of runoff from areas to be sewered; limitations of empirical formulas derived.

SEWAGE ANALYSIS. Sewage Analyses, R. Pomeroy. *Water Works & Sewerage*, vol. 87, no. 1, Jan. 1940, pp. 33–37. Discussions of methods of avoiding sewage analysis; errors due to improper sampling, improper test technique, and selection of tests; measures of sewage condition; special tests for oxidation plants; sludge analyses; bacterial tests.

SEWAGE FILTERS, VACUUM. Filter Dressing Rig, W. D. Sheets. *Water Works & Sewerage*, vol. 86, no. 12, Dec. 1939, pp. 490–491. Description of special rig, developed at sewage disposal plant of Columbus, Ohio, that saves time and materials in removal of spirally wound holding wire and spent cloth from vacuum filters.

SEWERS, OUTFALL. City's Sewage Goes to Sea—III, N. A. Bowers. *Eng. News-Rec.*, vol. 123, no. 25, Dec. 21, 1939, pp. 68–70. Operation and maintenance methods; costs and characteristics of major installations.

SLUDGE. Progress in Methods of Treatment and Disposal of Sewage Sludge, S. H. Jenkins. *Surveyor*, vol. 96, nos. 2498 and 2499, Dec. 8, 1939, pp. 475–477, and (discussion) Dec. 15, pp. 499–502. Abstract of paper before 1939 meeting of British Institute of Sewage Purification; history of sludge disposal; disposal at sea; land disposal; sludge digestion; methods of heating sludge; effect of concentration of sludge on digestion; effect of activated sludge on digestion; collection and use of gas; dewatering of sludge; sludge drying; use of sludge as manure.

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TRUSSES. Fast Erection of Building Trusses. *Eng. News-Rec.*, vol. 124, no. 1, Jan. 4, 1940, pp. 46–47. Rapid erection of three 106-ton trusses designed to carry eight stories of building over arge open show room in new Tiffany Building, New York City, by setting lower chord, web members, and upper chord in sequence; simple structure of heavy trusses obtained by interleaving single or multiple gusset plates with cover plates of H-section body of member.

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FLORIDA. Monuments for Municipal Surveys, E. M. Rader. *Eng. News-Rec.*, vol. 124, no. 1, Jan. 4, 1940, pp. 51–52. Description of field and office methods used for making precise survey and setting monuments in order to establish accurate control lines in Miami, Fla.

TRAFFIC CONTROL

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RAILROAD, IRAN. Der Bau des Scheiteltunnels der Elburs-Nordrampe der Transiranischen Eisenbahn, L. von Rabcewicz. *Bautechnik*, vol. 17, nos. 47/48 and 50, Nov. 3, 1939, pp. 593–598, and Nov. 24, pp. 615–617. Design and construction of single-track, masonry-lined railroad tunnel, 8 km long, under Gaduk Mountain pass on Trans-Iranian railroad; study of geological strata; list of construction equipment used; cost data.

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WATER PIPE LINES

LEAKAGE. Methods for Locating Underground Leaks. *Water Works Eng.*, vol. 93, no. 2, Jan. 17, 1940, pp. 80 and 83–84. Practical discussion of methods used for locating leaks that do not show on surface; training crews for finding leaks.

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FILTRATION PLANTS, OPERATION. Laboratory Control and Operating Experiences at The Hammond, Indiana, Filtration Plant, J. C. Vaughn. *Am. Water Works Assn.—J.*, vol. 31, no. 12, Dec. 1939, pp. 2137–2148. Experience of water filtration plant of Hammond, Ind., with threshold odor test; Baylis modification of threshold odor test; comparison of different kinds of coagulants; use of floc evaluator; breaking up of mud balls; danger of elimination of pre-chlorination.

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NEW YORK CITY. New York Fears Water Shortage, E. Nuebling. *Water Works Eng.*, vol. 93, no. 2, Jan. 17, 1940, pp. 67–71. Discussion of past and present water shortages in New York City.

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WATER SUPPLY, WAR TIME. Precautionary Measures Taken in England to Insure Water Supply in Time of War, J. S. Trevor. *Water Works Eng.*, vol. 93, no. 2, Jan. 17, 1940, pp. 62–63. Review of war-time protection measures of British water works structures; organization of emergency repair crews; fire emergency measures.